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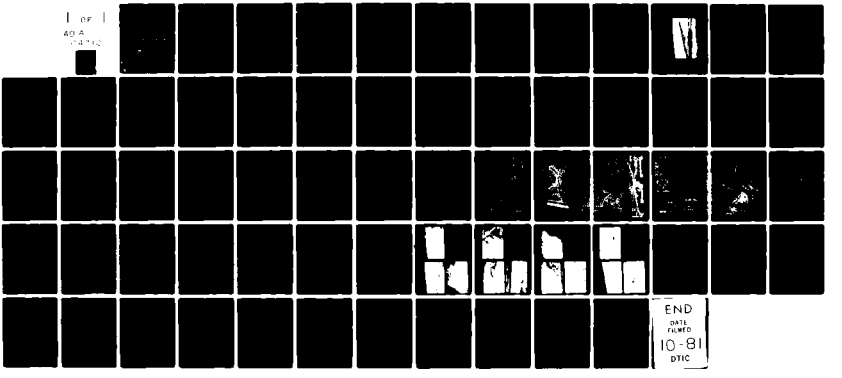

UPPER MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

WILDWOOD LAKE DAM

JEFFERSON COUNTY, MISSOURI

MO 30426

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
...Serving the Army
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St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

APRIL 1981

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REPORT DOCUMENTATION PAGE

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National Dam Safety Program. Wildwood Lake Dam (MO 30426), Upper Mississippi - Kaskaskia - St. Louis Basin, Jefferson County, Missouri. Phase I Inspection Report.

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18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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UPPER MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

WILDWOOD LAKE DAM

JEFFERSON COUNTY, MISSOURI

MO 30426

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
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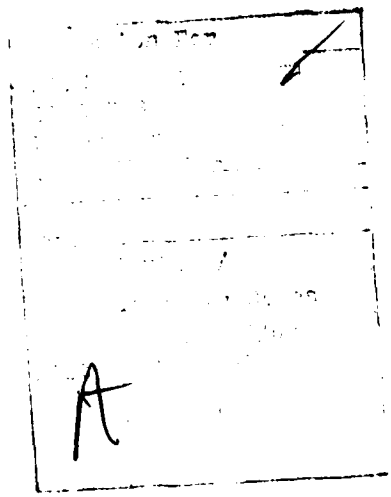
St. Louis District



PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

APRIL 1981

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

LMSED-P

SUBJECT: Wildwood Lake Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Wildwood Lake Dam (MO 30426):

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency ~~by the~~ St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.

2) Overtopping of the dam could result in failure of the dam.

3) Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED — 7 MAY 1981
Chief, Engineering Division — Date

APPROVED BY: SIGNED — 11 MAY 1981
Colonel, CE, District Engineer — Date

WILDWOOD LAKE DAM

MISSOURI INVENTORY NO. 30426

JEFFERSON COUNTY, MISSOURI

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

HORNER & SHIFRIN, INC.

5200 OAKLAND AVENUE

ST. LOUIS, MISSOURI 63110

FOR

U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

CORPS OF ENGINEERS

APRIL 1981

HS-8088

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Wildwood Lake Dam
State Located:	Missouri
County Located:	Jefferson
Stream:	Tributary of Plattin Creek
Date of Inspection:	20 November 1980

Wildwood Lake Dam, which according to the St. Louis District, Corps of Engineers, is of high hazard potential, was visually inspected by engineering personnel of Horner & Shifrin, Inc., Consulting Engineers, St. Louis, Missouri. The purpose of this inspection was to assess the general condition of the dam with respect to safety and, based upon this inspection and available data, determine if the dam poses an inordinate danger to human life or property. Evaluation of this dam was performed in accordance with the "Phase I" investigation procedures prescribed in "Recommended Guidelines for Safety Inspection of Dams", dated May 1975.

The following summarizes the findings of the visual inspection and the results of certain hydrologic/hydraulic investigations performed under the direction of the inspection team. Based on the visual inspection and the results of the hydrologic/hydraulic investigations, the present general condition of the dam is considered to be somewhat less than satisfactory, primarily due to the fact that the spillway capacity was found to be appreciably less than the recommended spillway design flood. Deficiencies observed during the visual inspection that are considered to have an adverse effect on the overall safety and future operation of the dam include such items as obstructions within the spillway approach channel, erosion of the spillway outlet channel, seepage, and small trees and brush on the upstream face of the dam.

According to the criteria set forth in the recommended guidelines, the magnitude of the spillway design flood for the Wildwood Lake Dam, which,

according to Table 1 of the guidelines, is classified as intermediate in size and of high hazard potential, is specified, according to Table 3 of the guidelines for a dam of high hazard potential and intermediate size, to be the Probable Maximum Flood (PMF). The Probable Maximum Flood (PMF) is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

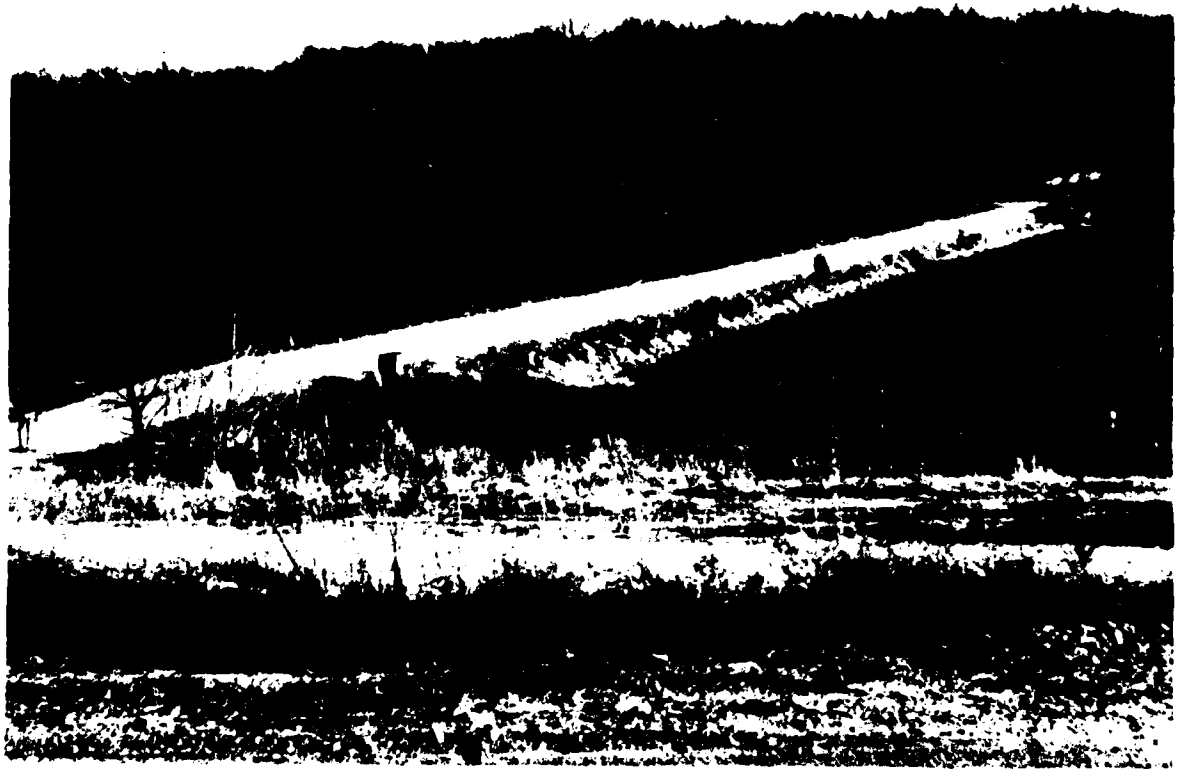
Results of a hydrologic/hydraulic analysis indicated that the spillway is inadequate to pass lake outflow resulting from a storm of PMF magnitude without overtopping the dam. The spillway is capable, however, of passing lake outflow resulting from the one percent chance (100-year frequency) flood and the outflow corresponding to about 20 percent of the PMF. According to the St. Louis District, Corps of Engineers, the length of the downstream damage zone, should failure of the dam occur, is estimated to be six miles. Accordingly, within the possible damage zone are six dwellings, a country club, and several other types of buildings.

A review of available data did not disclose that seepage or stability analyses of this dam were performed. This is considered a deficiency and should be rectified.

It is recommended that the Owner take the necessary action in the near future to correct or control the deficiencies and safety defects reported herein. The provision of additional spillway capacity should be pursued on a high priority basis.

Ralph E. Sauthoff
P. E. Missouri E-19090

Albert B. Becker, Jr.
P. E. Missouri E-9168



PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
WILDWOOD LAKE DAM - MO 30426

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

WILDWOOD LAKE DAM - MO 30426

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, dated 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, directed that a safety inspection of the Wildwood Lake Dam be made.

b. Purpose of Inspection. The purpose of this visual inspection was to make an assessment of the general condition of the above dam with respect to safety and, based upon available data and this inspection, determine if the dam poses an inordinate danger to human life or property.

c. Evaluation Criteria. This evaluation was performed in accordance with the "Phase I" investigation procedures as prescribed in "Recommended Guidelines for Safety Inspection of Dams," Appendix D to "Report to the Chief of Engineers on the National Program of Inspection of Non-Federal Dams," dated May 1975.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. The Wildwood Lake Dam is an earthfill type embankment rising approximately 44 feet above the original streambed at the downstream toe of the barrier. The embankment has an upstream slope (above the waterline) of about 1v on 1.2h, a crest width of about 28 feet, and a downstream slope which varies from a minimum of approximately 1v on 2.1h to a maximum of about 1v on 1.7h. The length of the dam is approximately 652 feet. The upstream face of the dam is protected by stone riprap and a roadway covered with gravel and crushed stone traverses the dam crest. A 10-inch pipe extends beneath the dam at the location of the

original stream channel. According to the dam builder, the pipe, an Armco "Truss pipe" section, was installed to drain stormwater runoff from the lake area during construction of the dam, and following completion of the dam, the downstream end of the pipe was capped. A plan and profile of the dam are shown on Plate 4, and a cross-section of the dam at about the location of the original stream on which the dam was built is shown on Plate 5. At normal pool level, the reservoir impounded by the dam occupies approximately 14 acres. An overview photo of the dam is shown following the preface at the front of the report.

The principal spillway, a culvert consisting of six 20-inch high by 28-inch wide corrugated metal pipe arch sections, is located at the left, or north, abutment. The pipes are uncontrolled. The earthfilled section above the pipes which is also part of the dam, serves as an emergency spillway. The roadway that traverses the dam crest also crosses the spillway. An earthen bank about 70 feet long extends from the dam toward the reservoir and serves to channel flow to the spillway. The spillway approach channel and the spillway outlet channel are common to both the principal and emergency spillways. An earthen bank that extends about 110 feet downstream of the dam along the right side of the spillway outlet channel serves to confine flow to the outlet channel. About 160 feet downstream of the dam, the spillway outlet channel joins a natural draw which, in turn, joins the original stream channel at a point approximately 220 feet downstream of the dam toe. A profile and cross-section of the spillway are shown on Plate 6.

b. Location. The dam is located on an unnamed tributary of Plattin Creek, within the Wildwood Lake Subdivision. The subdivision, a residential development, lies just north of and adjacent to Wegman Road, about 1.5 miles east of U. S. Highway 67, and approximately 6 miles east of the City of DeSoto, Missouri. The dam is located in the southwest one-quarter of Section 2, Township 39 North, Range 5 East, within Jefferson County. A plat of the Wildwood Lake Subdivision showing the lake and dam is shown on Plate 2.

c. Size Classification. The size classification based on the height of the dam and storage capacity, is categorized as intermediate. (Per Table 1, Recommended Guidelines for Safety Inspection of Dams.) An intermediate size

dam is classified, according to the guidelines, as having a height less than 100 feet, but greater than or equal to 40 feet and/or a storage capacity less than 50,000 acre-feet, but greater than or equal to 1,000 acre-feet.

d. Hazard Classification. Wildwood Lake Dam, according to the St. Louis District, Corps of Engineers, has a high hazard potential, meaning that if the dam should fail, there may be loss of life, serious damage to homes, or extensive damage to agricultural, industrial and commercial facilities, important public utilities, main highways, or railroads. The estimated flood damage zone, should failure of the dam occur, as determined by the St. Louis District, extends six miles downstream of the dam. Within the possible damage zone are six dwellings, a country club, and several other types of buildings. Those features lying within the downstream damage zone reported by the Corps of Engineers, St. Louis District, were verified by the inspection team.

e. Ownership. The lake and dam are owned by Wildwood Lake, Inc., a Missouri corporation. The corporation's address is: Box 302, Crystal City, Missouri 63019. Charles R. Penberthy is President. Mr. Penberthy served as the Owner's representative during the course of these investigations.

f. Purpose of Dam. The dam impounds water for recreational use.

g. Design and Construction History. According to Mr. Penberthy, the Bloomsdale Excavating Company of Bloomsdale, Missouri began construction of the dam in 1971 and completed it in 1972. Mr. Marvin Drury, President of the Bloomsdale Excavating Company, indicated that his firm laid out the dam and sized the spillway based on their experience with other dams of similar size. An engineering geology report of the proposed dam site was made by Edwin C. Lutzen (deceased), a geologist with the Missouri Geological Survey. This report, dated March 31, 1971, is included herewith, reference Chart 2-1. No other engineering data relating to the design or construction of the dam was available.

h. Normal Operational Procedures. The lake level is unregulated. Lake outflow is governed by the capacity of a multiple pipe culvert type spillway.

1.3 PERTINENT DATA

a. Drainage Area. The Wildwood Lake Subdivision occupies approximately one-half of the lake watershed. With the exception of the improved areas of the subdivision, the drainage area tributary to the lake is for the most part in a native state covered with timber. The watershed above the dam amounts to approximately 266 acres. The watershed area and subdivision boundary are outlined on Plate 3.

b. Discharge at Damsite.

(1) Estimated known maximum flood at damsite ... 70 cfs* (W.S. Elev. 557.4)
(2) Spillway capacity ... 189 cfs (W.S. Elev. 560.2)

c. Elevation (Ft. above MSL). The following elevations were determined by survey and are based on topographic data shown on the 1964 Festus, Missouri, Quadrangle Map, 7.5 Minute Series.

(1) Observed pool ... 555.5
(2) Normal pool ... 556.0
(3) Spillway crest
    a. Principal ... Varies, 556.0 (min.) to 556.4
    b. Emergency ... 559.8
(4) Maximum experienced pool ... 557.4*
(5) Top of dam ... 560.2 (Min.)
(6) Streambed at centerline of dam ... 518± (Est.)
(7) Maximum tailwater ... Unknown
(8) Observed tailwater ... None

d. Reservoir.

(1) Length at normal pool (Elev. 556.0) ... 1,800 ft.
(2) Length at maximum pool (Elev. 560.2) ... 2,050 ft.

*Based on an estimate of depth of flow at spillway as observed by C. R. Penberthy.

e. Storage.

(1) Normal pool ... 166 ac. ft.
(2) Top of dam (incremental) ... 66 ac. ft.

f. Reservoir Surface Area.

(1) Normal pool ... 14 acres
(2) Top of dam (incremental) ... 4 acres

g. Dam. The height of the dam is defined to be the overall vertical distance from the lowest point of foundation surface at the downstream toe of the barrier to the top of the dam.

(1) Type ... Earthfill
(2) Length ... 652 ft.
(3) Height ... 44 ft.
(4) Top width ... 28 ft.
(5) Side slopes
    a. Upstream ... 1v on 1.2h (above waterline)
    b. Downstream ... 1v on 1.7h maximum; 1v on 2.1h minimum
(6) Cutoff ... Core trench*
(7) Slope protection
    a. Upstream ... Stone riprap
    b. Downstream ... Grass

h. Principal Spillway.

(1) Type ... Culvert, uncontrolled, six 20-inch high by 28-inch wide corrugated metal pipe arch sections
(2) Location ... Left abutment
(3) Crest elevation ... Varies, 556.0 (min.) to 556.4

*Per C. R. Penberthy.

(4) Approach channel ... Excavated earth, trapezoidal section
   a. Bottom width = 30± feet
   b. Side slopes = 1v on 2h (approx.)
   c. Channel slope = 0.020± feet per foot
(5) Exit channel ... Excavated earth, trapezoidal section
   a. Bottom width = 30± feet
   b. Side slopes = 1v on 2h (approx.)
   c. Channel slope = 0.015 feet per foot (min.)

i. Emergency Spillway.

(1) Type ... Dish-shaped section, crushed stone and gravel surface
(2) Location ... Left abutment, above principal spillway
(3) Crest ... Elevation 559.8
(4) Approach channel ... Common with principal spillway
(5) Exit channel ... Common with principal spillway

j. Lake Drawdown Facility ... A 10-inch diameter pipe, capped at the downstream end, extends through the dam at about the location of the original stream channel. If required, the end of the pipe could be removed and the reservoir drained.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

With the exception of an engineering geology report prepared by Edwin E. Lutzen (deceased), a geologist with the Missouri Geological Survey, no data relating to the design of the dam are known to exist. In the report, reference Chart 2-1, which is dated March 31, 1971, Mr. Lutzen states that he believes that the dam (and reservoir) has a good chance for success provided that there is a sufficient amount of core trench provided across the centerline of the dam. Details of constructing the core trench are included along with the recommendation that the blasting work be done by an experienced professional.

2.2 CONSTRUCTION

As previously stated, construction of the Wildwood Lake Dam was completed in 1972 and the builder of the dam was the Bloomsdale Excavating Company. No formal records regarding the construction of the dam are known to exist. According to Marvin Drury, President of the Bloomsdale Excavating Company, a seepage cutoff trench with a minimum width of about 14 feet and a depth which varied from approximately 4 to 8 feet, was excavated to solid rock along the centerline of the dam. Mr. Drury indicated that fill for the core trench and embankment was clay removed from the area now occupied by the lake and from the hillside located to the north of the dam. According to the Owner's representative, C. R. Penberthy, the fill within the core trench was compacted with a sheepsfoot roller. Mr. Drury reported that the material in the embankment was placed in lifts about 8 inches deep and compacted by the rubber-tired earth moving equipment.

According to Mr. Drury, the dam was constructed with an upstream slope of 1v on 3h, and a downstream slope of 1v on 2h. Survey data obtained at the time of the inspection indicates the downstream slope to be on the order of 1v on 2h. However, the upstream slope was found to be approximately 1v on 1.2h above the waterline. The slope of the upstream face of the dam below the waterline was not determined during the inspection. Mr. Drury also reported

that a 10-inch pipe, an Armco "Truss-pipe" section, was used to drain stormwater runoff from the lake area during construction of the dam, and that the pipe extends through the dam at about the location of the original stream, has several concrete anti-seepage collars, and is capped at the downstream end.

2.3 OPERATION

The lake level is uncontrolled and governed by the crest elevation of one of the six spillway pipes located at the left abutment. No indication was found that the dam had been overtopped. Mr. C. R. Penberthy reported that the dam has never been overtopped and that the highest lake surface elevation he has observed occurred in April of 1979, and again in the spring of 1980, when the lake level was about 3 inches from the top of the spillway pipes or about 1.4 feet above the normal pool level.

2.4 EVALUATION

a. Availability. Detailed engineering data for assessing the design of the dam and spillway were unavailable.

b. Adequacy. No data available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Wildwood Lake Dam was made by Horner & Shifrin engineering personnel, R. E. Sauthoff, Civil Engineer, H. B. Lockett, Hydrologist, and A. B. Becker, Jr., Civil and Soils Engineer, on 20 November 1980. Mr. Penberthy, the Owner's representative, was present during this inspection. An examination of the dam area was also made by an engineering geologist, Jerry D. Higgins, Ph.D., a consultant retained by Horner & Shifrin for the purpose of assessing the site geology. Also examined at the time of the inspection were the areas and features below the dam within the potential flood damage zone. Photographs of the dam taken at the time of the inspection are included on pages A-1 through A-4 of Appendix A. The locations of the photographs taken during the inspection are indicated on Plate 4.

b. Site Geology. Lake Wildwood is located on an unnamed tributary to Plattin Creek. The topography around the lake site is moderately sloping, and the topographic relief ranges up to approximately 240 feet. The area is included within the northeastern part of the Ozark Plateaus Physiographic Province, and regionally the bedrock dips northeastward into the Illinois Basin.

The reservoir and dam are underlain by the Ordovician-age Jefferson City-Cotter formation. Good exposures of the bedrock are present along the east shoreline and in the spillway channel. The formation consists primarily of a light brown to gray, finely crystalline, argillaceous dolomite. It is generally thin- to medium-bedded and contains both nodular and bedded chert, as well as some thin sandstone layers. Solution weathering commonly enlarges joints and bedding planes, and the contact between bedrock and the overlying soils is generally very irregular as a result of the solution activity. These weathering features are commonly the cause of excessive reservoir leakage when soil cover is thin. No faulting was noted or reported in the vicinity of the dam site.

The soils were derived from the in-place weathering of the dolomite bedrock. They are reddish-brown to buff-colored, moderately plastic clays (CL, Unified Soil Classification) and contain abundant chert fragments. These soils do not appear to be highly erodible, but are somewhat permeable. However, they generally form stable embankments for small reservoirs.

The most significant geologic condition noted at the site was the permeable bedrock. The soils are obviously thin at the abutments, and a high water loss is possible. No other geologic conditions were noted that would adversely affect the stability of the embankment or performance of the reservoir.

c. Dam. The visible portions of the upstream and downstream faces of the dam (see Photos 1, 2 and 3) as well as the dam crest were inspected and appeared to be in sound condition. No undue settlement of the dam crest, sliding or sloughing of the embankment slopes, or misalignment of the dam were noted. Stone riprap up to about 18 inches in diameter extended from below the waterline to about 1 foot above normal pool level along the upstream face of the dam. Above the riprap the upstream face was covered with a growth of weeds up to 3 feet high. Several areas of brush as well as trees up to 2 inches in diameter were also present on the upstream face of the dam. The crushed stone and gravel roadway which traverses the dam crest was found to be in satisfactory condition and no cracks were noted in the surface of the structure. The downstream face of the dam was well covered with a fescue-type grass about six inches tall with a few areas of weeds up to 3 feet tall. An examination of a sample of the surficial material obtained from the downstream face of the dam at about the center of the structure indicated it to be a brown, gravelly, silty lean clay (CL) of low-to-medium plasticity.

Some seepage, as evidenced by cattails, soft ground, and standing water (see Photos 10 and 11) was observed in a marshy area about 125 feet long and 50 feet wide, located adjacent to the downstream toe, between stations 1+50 and 2+75. The amount of seepage at this location could not be determined; however, the quantity appeared to be rather minor. Seepage was also evident in an area near the downstream end of the 10-inch pipe (see Photo 12) located near station 3+85. The area, about 10 feet wide by 15 feet long, contained

soft ground and standing water as well as water estimated to be flowing at a rate of about one-half gallon per minute. The downstream end of the 10-inch pipe (see Photo 9) was found to be below the level of the surrounding ground. According to Mr. Penberthy and the dam builder, there is no valve on the pipe and flow is prevented by a cap on the downstream end of the pipe.

The visible portions of the six 20-inch high by 28-inch wide corrugated metal pipes of the principal spillway (see Photos 5 and 6) appeared to be in sound condition. However, soil that appeared to be sediment from the spillway approach channel had partially blocked the entrance to the pipe located at the left side of the culvert. A moderately dense growth of cattails and small willow trees (see Photo 4) were also present within the excavated earth spillway approach channel. The embankment at the spillway pipes appeared to be in sound condition since no indication of settlement or loss of material due to erosion was noticed. The excavated earth spillway outlet channel (see Photo 7), was found to be in satisfactory condition near the spillway crest. However, beginning at a point about 100 feet downstream of the dam centerline, the channel (see Photo 8) had been eroded to bedrock resulting in steep, nearly vertical, 4-foot high, banks. However, the erosion of the channel at this location did not appear to threaten the embankment.

d. Appurtenant Structures. No appurtenant structures were observed at this dam site.

e. Downstream Channel. Except at roadway crossings, the channel downstream of the dam within the estimated flood damage zone is unimproved. The section is irregular and for the most part, lined with trees. The stream joins Plattin Creek about two miles downstream of the dam.

f. Reservoir. With the exception of improved areas such as roads, dwellings, etc., within the Wildwood Lake Subdivision, the hillsides surrounding the lake are for the most part in a native state covered with timber. No significant erosion of the lake banks was evident, and the shoreline appeared to be well maintained. At the time of the inspection, the lake surface was about 0.5 foot below normal pool level and the water within the reservoir was clear. The amount of sediment within the lake at the time

of inspection could not be determined; however, due to the vegetation covering the surrounding area and the fact that the lake shoreline is well maintained, it is believed to be insignificant.

3.2 EVALUATION

The deficiencies observed during this inspection and noted herein are not considered of significant importance to warrant immediate remedial action.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The spillways are uncontrolled. The lake level is governed by precipitation runoff, evaporation, seepage, and the combined capacities of the uncontrolled spillways.

4.2 MAINTENANCE OF DAM

According to C. R. Penberthy, the Owner's representative, muskrats are removed from the dam area each year by trapping. Mr. Penberthy also stated that the area upstream of the spillway pipes is to be cleared sometime in the near future.

4.3 MAINTENANCE OF OPERATING FACILITIES

No facilities requiring operation exist at this dam, and there is no reservoir regulating plan.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

Mr. Penberthy, who resides within the Wildwood Lake Subdivision, indicated that the spillways are checked during periods of heavy precipitation, and that the local authorities would be notified in the event of an emergency, such as overtopping or imminent failure of the dam. No other dam failure warning system is known to exist.

4.5 EVALUATION

It is recommended that maintenance of the dam include removal of trees and periodic cutting of grass on the slopes. Measures should be taken to remove obstructions such as growths of cattails from the spillway approach channel and to prevent further erosion of the spillway outlet channel. The spillway pipes should also be kept clear of sediment that will restrict the discharge capacity of the outlet. It is also recommended that a detailed inspection

of the dam be instituted on a regular basis by an engineer experienced in the design and construction of dams and that records be kept of all inspections made and remedial measures taken.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Design data were not available.

b. Experience Data. The watershed and lake surface area were developed from the 1964 Festus, Missouri, Quadrangle Map. The proportions and dimensions of the spillways and dam were developed from surveys made during the inspection. Records of rainfall, streamflow or flood data for the watershed were not available.

Due to the fact that the watershed for this reservoir is relatively small and since there is no history of excessive reservoir leakage that would adversely affect the normal operating level of the lake, the lake level was assumed to be at normal pool as a result of antecedent storms prior to occurrence of the PMF and the probabilistic storm.

According to the St. Louis District, Corps of Engineers, the estimated flood damage zone, should failure of the dam occur, extends six miles downstream of the dam.

c. Visual Observations.

(1) The spillway consists of six 20-inch high by 28-inch wide corrugated metal pipe arch sections, each about 30 feet long. The spillway, a culvert type structure, passes through the abutment at the left end of the dam.

(2) The emergency spillway, a dish-shaped section located directly above the spillway pipes, is surfaced with gravel and crushed stone.

(3) The spillway outlet channel which is common to both spillways, consists of an excavated earth trapezoidal section. The channel directs flow away from the embankment and joins a natural draw about 160 feet downstream of the dam. Lake outflow within the capacity of the spillway channel is not expected to endanger the dam.

d. Overtopping Potential. The spillway is inadequate to pass the probable maximum flood, or 1/2 the probable maximum flood, without overtopping the dam. The spillway is adequate, however, to pass the 1 percent chance (100-year frequency) flood without overtopping the dam. The results of the dam overtopping analysis are as follows:

(Note: The data appearing in the following table have been extracted from the computer output data appearing in Appendix B. Decimal values have been rounded to the nearest one-tenth in order to prevent assumption of unwarranted accuracy.)

Ratio of PMF	Q-Peak Outflow (cfs)	Max. Lake W.S. Elev.	Max. Depth (Ft.) of Flow over Dam (Elev. 560.2)	Duration of Overtopping of Dam (Hrs.)
0.50	2,252	561.5	1.3	5.0
1.00	4,800	562.3	2.1	7.4
1% Chance Flood	139	559.4	0.0	0.0

Elevation 560.2 was found to be the elevation of the low area of the dam crest. The flow safely passing the spillways just prior to overtopping amounts to approximately 189 cfs, which is the routed outflow corresponding to about 20 percent of the probable maximum flood inflow. It was determined that the spillway discharge just prior to overtopping would result in velocities of about 2.5 feet per second at the crest of the emergency spillway, which is less than the assumed maximum non-erosive velocity of 5.0 feet per second, and therefore, acceptable. During peak flow of the probable maximum flood, the greatest depth of flow over the dam is projected to be 2.1 feet and overtopping will extend across the entire length of the dam.

e. Evaluation. Experience with embankments constructed of similar material (a silty lean clay of low-to-medium plasticity) to that used to construct this dam has shown evidence that the material under certain conditions, such as high velocity flow, can be very erodible. Such a condition exists during the PMF when large lake outflow, accompanied by high flow velocities, occurs. For the PMF condition where the depth of flow over

the dam crest, a maximum of 2.1 feet, and the duration of flow over the dam, 7.4 hours, are substantial, damage by erosion to the crest and downstream face of the dam is expected. The extent of these damages is not predictable within the scope of these investigations; however, there is a possibility that they could result in failure by erosion of the dam.

f. Reference. Procedures and data for determining the probable maximum flood, the 100-year frequency flood, and the discharge rating curve for flow passing the spillway and dam crest are presented on pages B-1 through B-3 of Appendix B. Listings of the HEC-1 (Dam Safety Version) input data for both the probable maximum flood and the 100-year frequency flood are shown on pages B-4 through B-6. Computer output data, including unit hydrograph ordinates, tabulation of PMF rainfall, loss and inflow data are shown on pages B-7 through B-10; tabulation of lake surface area, elevation and storage volume is shown on page B-11 and tabulation titled "Summary of Dam Safety Analysis" for the PMF and 1 percent chance (100-year frequency) flood are also shown on page B-11. Tables of spillway capacity at various elevations are shown on pages B-12 and B-13.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions which adversely affect the structural stability of the dam are discussed in Section 3, paragraph 3.1c.

b. Design and Construction Data. No design or construction data relating to the structural stability of the dam are known to exist. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Operating Records. No appurtenant structures or facilities requiring operation exist at this dam. According to C. R. Penberthy, the Owner's representative, no records are kept of the lake level, spillway discharge, dam settlement, or seepage.

d. Post Construction Changes. Information available indicated that no post construction changes have been made or have occurred which would affect the structural stability of the dam.

e. Seismic Stability. The dam is located in a Zone II seismic probability area. An earthquake of the magnitude that might occur in this area would not be expected to cause structural damage to a well constructed earth dam of this size provided that static stability conditions are satisfactory and conventional safety margins exist. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. A hydraulic analysis indicated that the spillway is capable of passing lake outflow of about 189 cfs without the level of the lake exceeding the low area in the top of the dam. A hydrologic analysis of the lake watershed area, as discussed in Section 5, paragraph 5.1d, indicated that for storm runoff of probable maximum flood magnitude, the lake outflow would be on the order of 4,800 cfs, and that for the 1 percent chance (100-year frequency) flood, the lake outflow would be about 139 cfs. Since the existing spillway is inadequate to pass lake outflow resulting from a storm of probable maximum flood magnitude (the recommended spillway design flood for this dam) without overtopping the dam, the possibility exists that overtopping could result in failure by erosion of the dam. A description of the features located within the potential flood damage zone should failure of the dam occur is included in Section 1, paragraph 1.2d.

Seepage and stability analyses of the dam were not available for review and therefore no judgment could be made with respect to the structural stability of the dam.

Several items were noticed during the visual inspection that could adversely affect the safety of the dam. These items include obstructions within the spillway approach channel, erosion of the spillway outlet channel, seepage, and small trees and brush on the upstream face of the dam.

b. Adequacy of Information. Due to lack of design and construction data, the assessments reported herein were based on external conditions as determined during the visual inspection. The assessment of the hydrology of the watershed and capacity of the spillway were based on a hydrologic/hydraulic study as indicated in Section 5. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. The remedial measures recommended in paragraph 7.2 for the items concerning the safety of the dam noted in paragraph 7.1a should be accomplished some time in the near future. The item recommended in paragraph 7.2a concerning spillway capacity should be pursued on a high priority basis.

d. Necessity for Phase II. Based on the results of the Phase I inspection, a Phase II investigation is not recommended.

e. Seismic Stability. The dam is located in a Zone II seismic probability area. An earthquake of the magnitude that might occur in this area would not be expected to cause structural damage to a well constructed earth dam of this size provided that static stability conditions are satisfactory and conventional safety margins exist. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES

a. Recommendations. The following actions are recommended:

(1) Based upon criteria set forth in the recommended guidelines, spillway size and/or height of dam should be increased to pass lake outflow resulting from a storm of probable maximum flood magnitude, which is the recommended spillway design flood for this dam. In either case, the spillway should be protected to prevent erosion.

(2) Obtain the necessary soil data and perform dam seepage and stability analyses in order to determine the structural stability of the dam for all operational conditions. Seepage and stability analyses should be performed by a qualified professional engineer experienced in the design and construction of dams.

b. Operations and Maintenance (O & M) Procedures. The following O & M Procedures are recommended:

(1) Remove the cattails, small willow trees and sediment from the area of the spillway approach channel. Obstructions that impede flow to the spillway can reduce outlet capacity which could result in damage or failure of the dam due to overtopping.

(2) Restore the eroded area of the spillway outlet channel and provide some form of protection to prevent further erosion by lake outflow. Continued erosion of the outlet channel could endanger the stability of the channel banks.

(3) Provide some means of controlling the seepage evident in the areas adjacent to the downstream toe of the dam. Uncontrolled seepage can develop into a piping condition (progressive internal erosion) which can lead to failure of the dam. Drainage of the area affected by seepage should be one of the objectives of the seepage control measures since saturation of the soil weakens the foundation which could impair the stability of the dam. It is recommended that an engineer experienced in the design and construction of earth dams supervise the installation of the seepage control features.

(4) Remove the small trees and brush that may conceal animal burrows from the upstream face of the dam. Tree roots and animal burrows can provide passageways for lake seepage that could also lead to a piping condition and failure of the dam.

(5) Provide maintenance of all areas of the dam and spillway on a regularly scheduled basis in order to insure features of being in satisfactory operational condition.

(6) A detailed inspection of the dam should be instituted on a regular basis by an engineer experienced in the design and construction of dams. It is also recommended, for future reference, that records be kept of all inspections made and remedial measures taken.

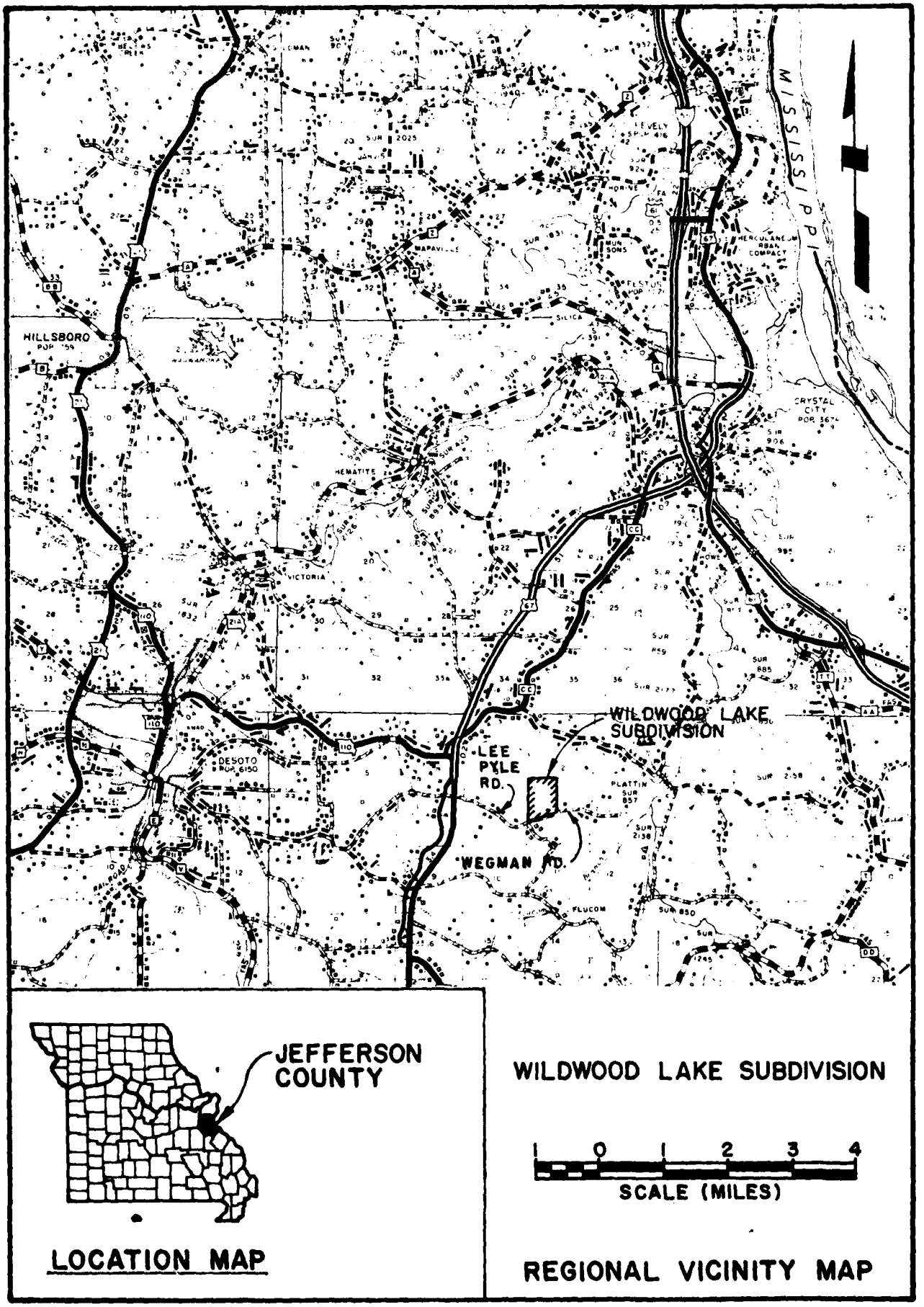
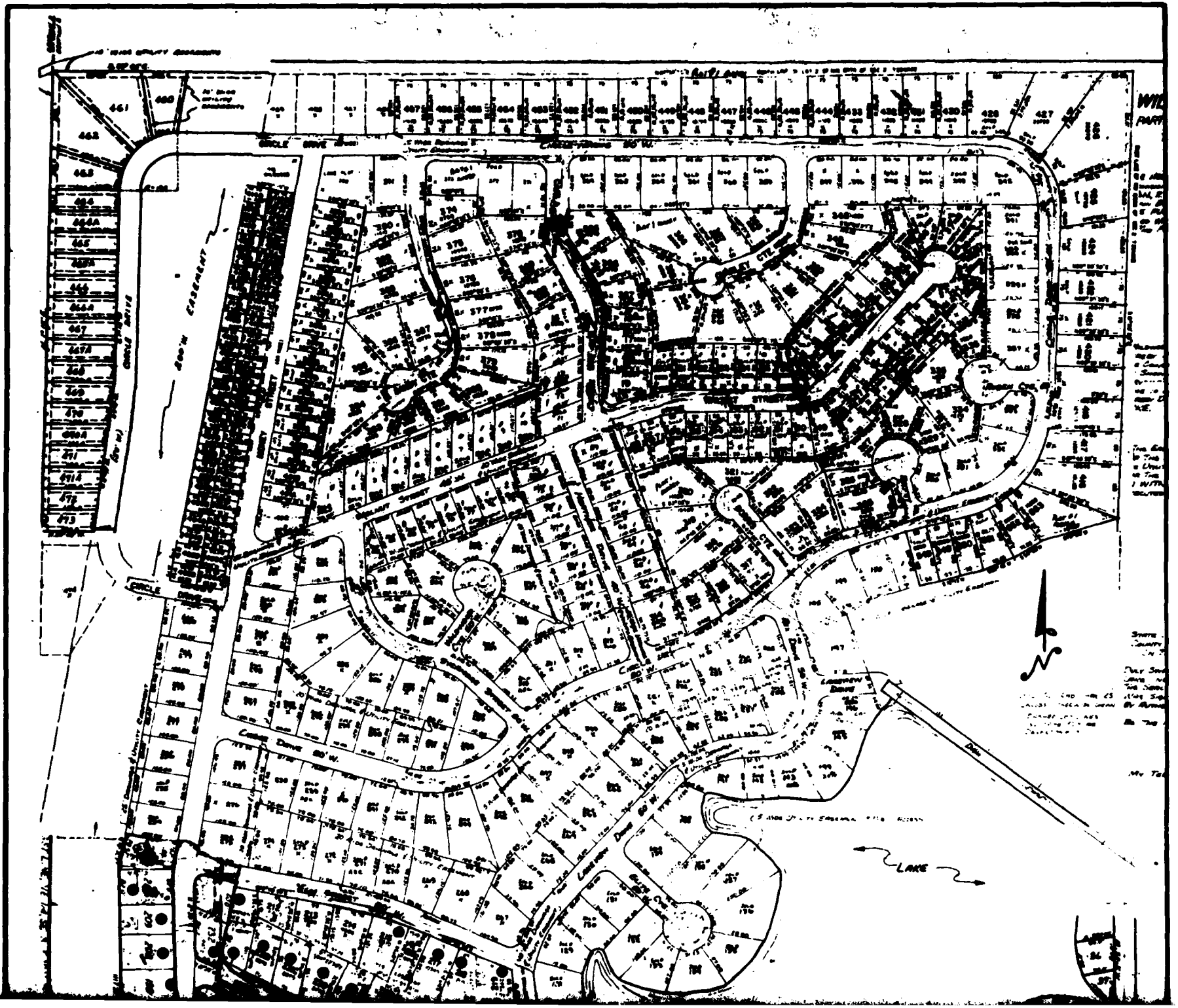
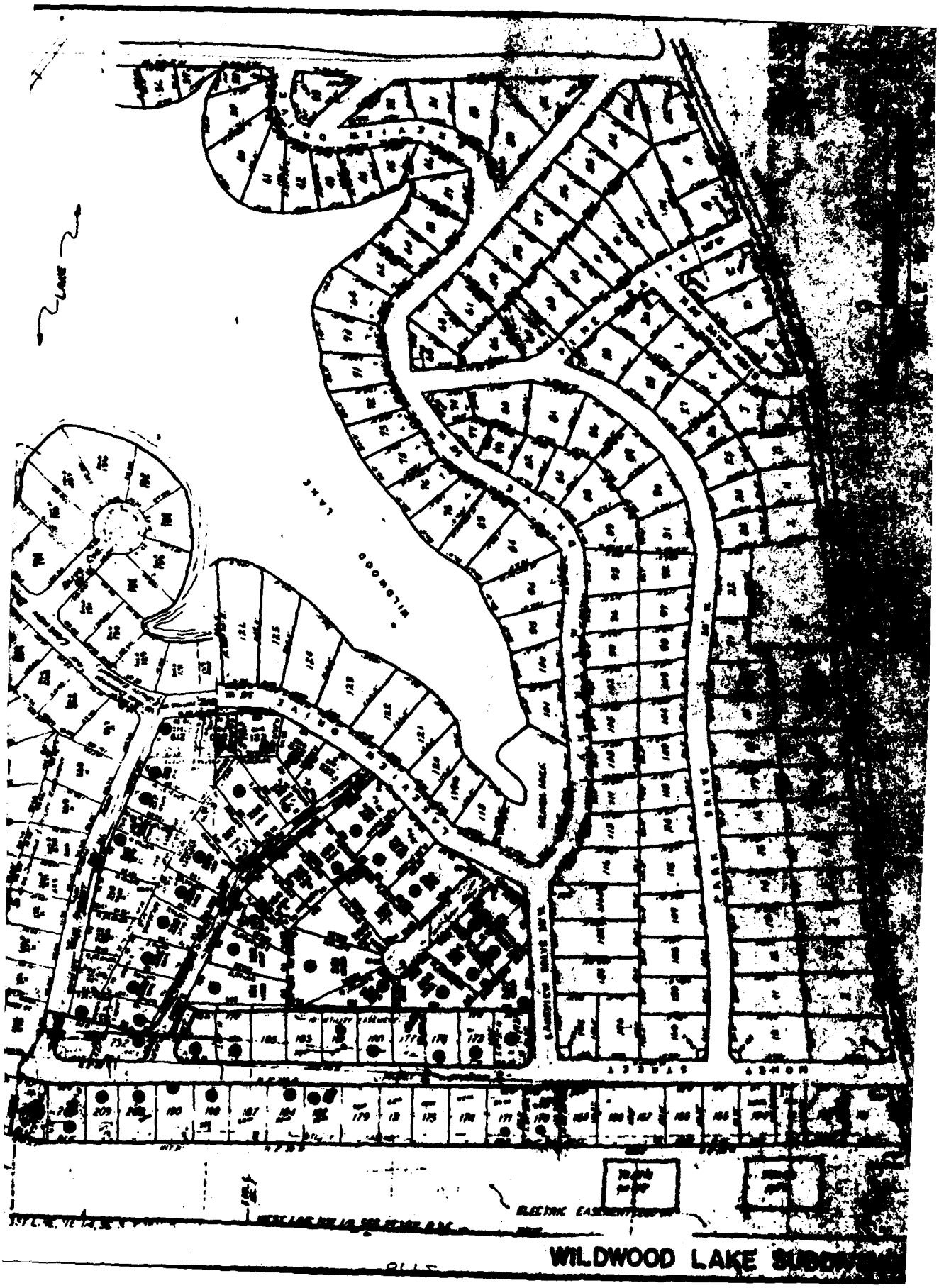
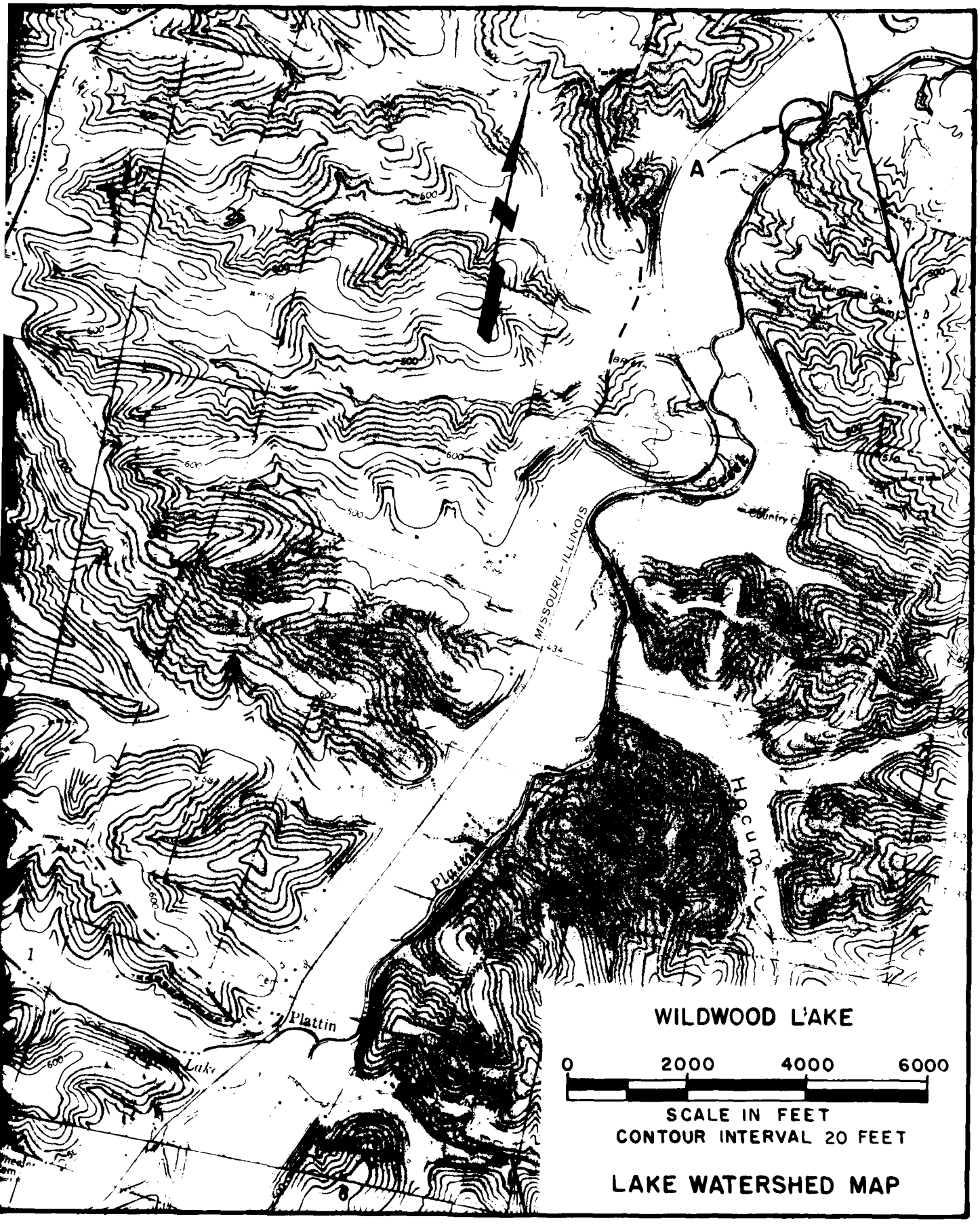

MISSISSIPPI
HILLSBORO
POP. 1556
CRYSTAL CITY
POP. 3674
HEMATITE
VICTORIA
DESOTO
POP. 6150
WILDWOOD LAKE SUBDIVISION
LEE PYLE RD.
WEGMAN RD.
PLATTIN
FLUCOM
JEFFERSON COUNTY
LOCATION MAP
WILDWOOD LAKE SUBDIVISION
1 0 1 2 3 4
SCALE (MILES)
REGIONAL VICINITY MAP

PLATE 1


CIRCLE DRIVE
CIRCLE
LAKE

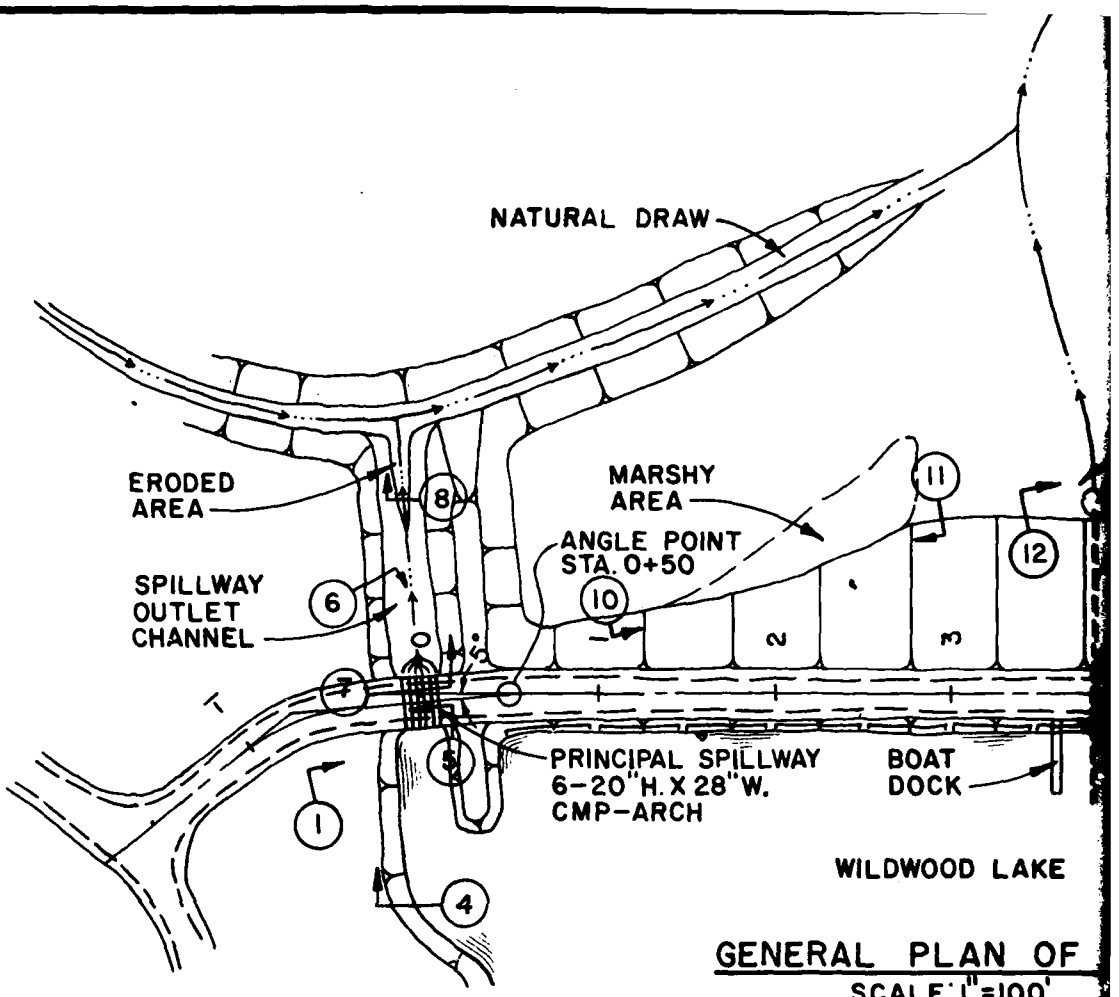

LAKE
LAKE
GOODNOW
WILDWOOD LAKE


WILDWOOD LAKE
SUBDIVISION BOUNDARY
SPILLWAY
DAM
WILDWOOD LAKE
WEGMAN ROAD
A = APPROXIMATE EXTENT OF DOWNSTREAM FLOOD DAMAGE ZONE


A
MISSOURI - ILLINOIS
Plattin
Plattin
Lake
WILDWOOD LAKE
0
2000
4000
6000
SCALE IN FEET
CONTOUR INTERVAL 20 FEET
LAKE WATERSHED MAP

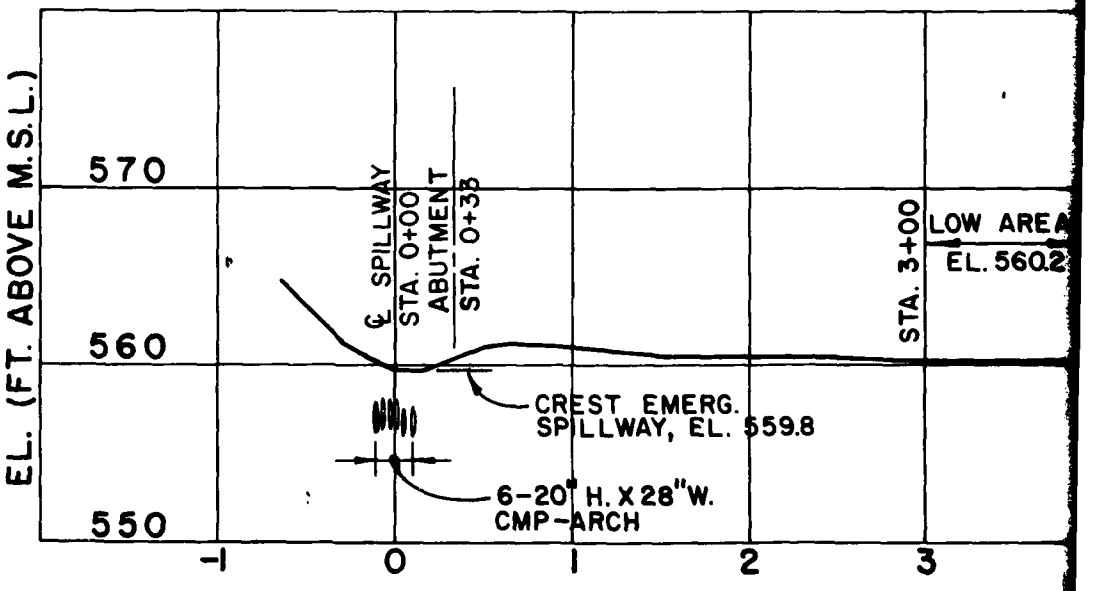
12

PLATE 3



GENERAL PLAN OF

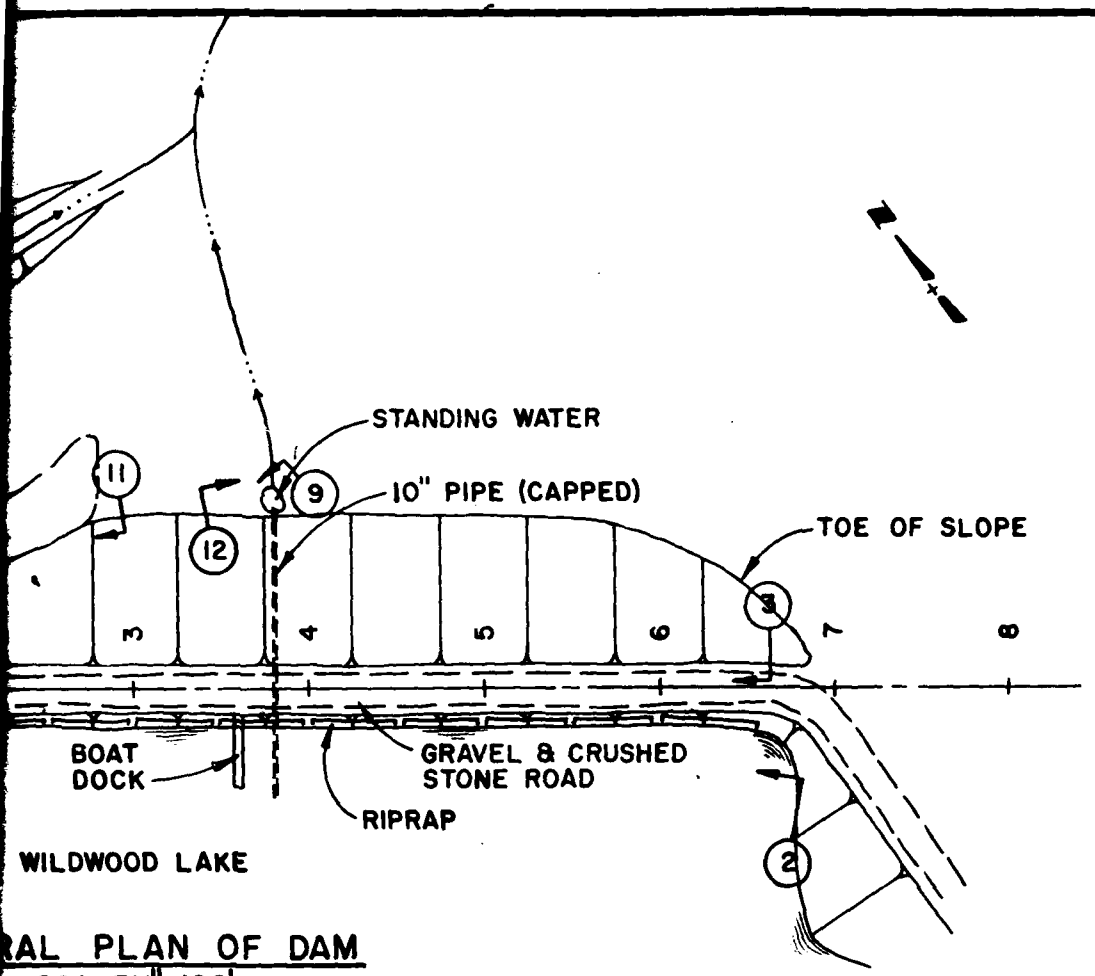
SCALE: 1" = 100'



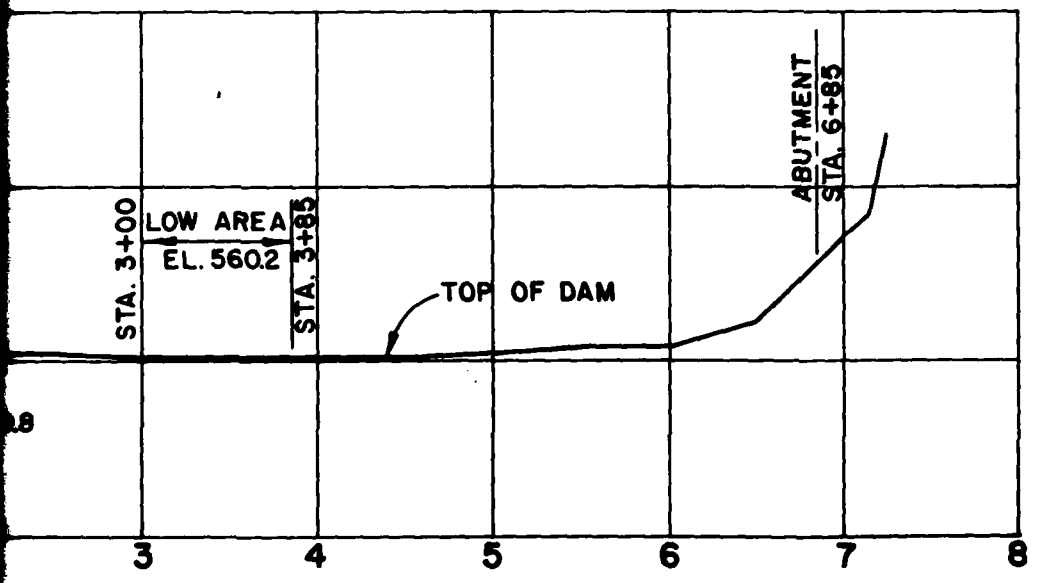
PROFILE DAM CR

SCALES: 1" = 10' V., 1" = 100

(6) PHOTO LOCATION & KEY (SEE APPENDIX A)



RAL PLAN OF DAM
SCALE: 1"=100'



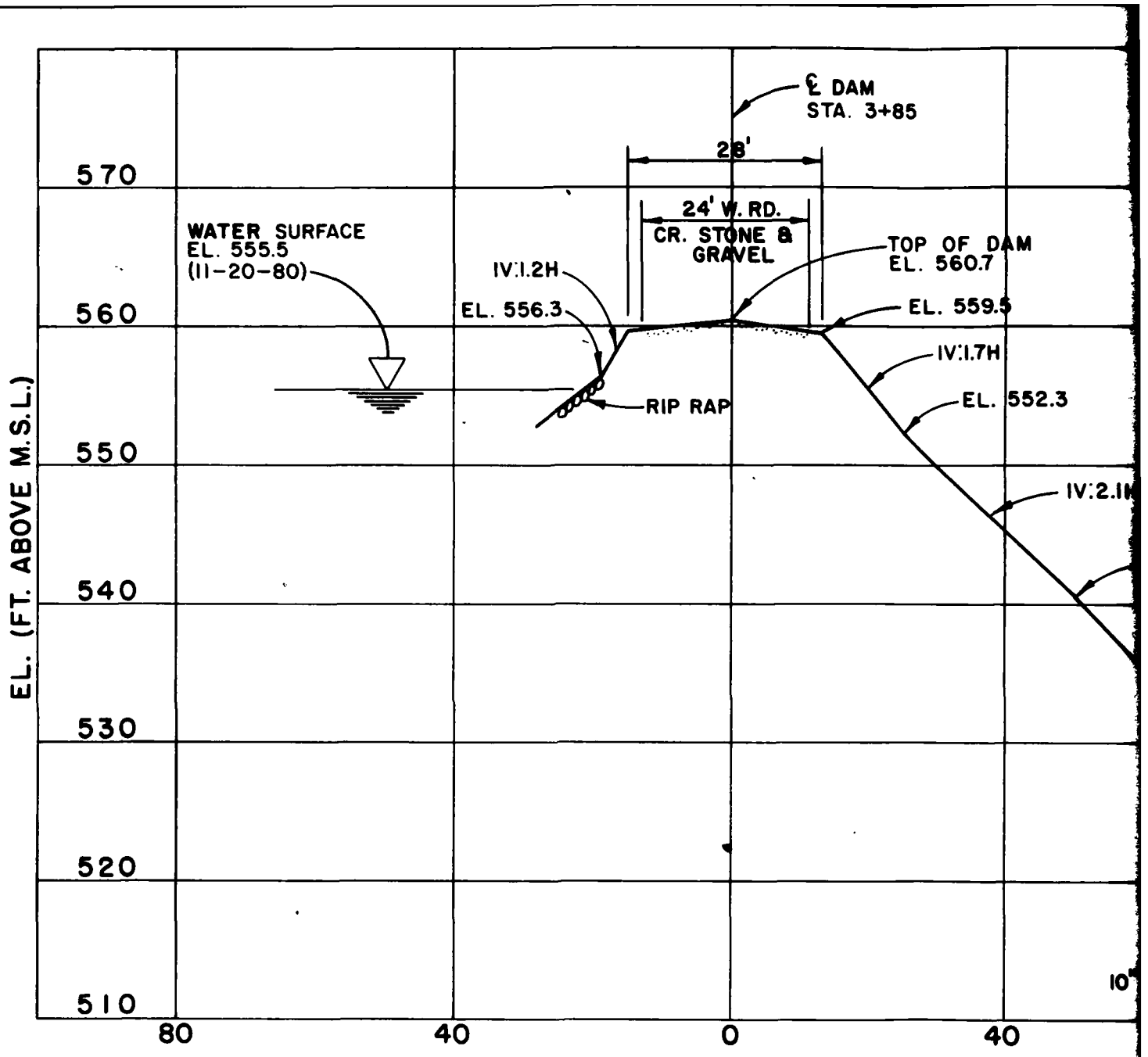
FILE DAM CREST
ALES: 1"=10' V., 1"=100' H.

WILDWOOD LAKE
DAM PLAN & PROFILE

Horner & Shifrin, Inc. Jan. 1981

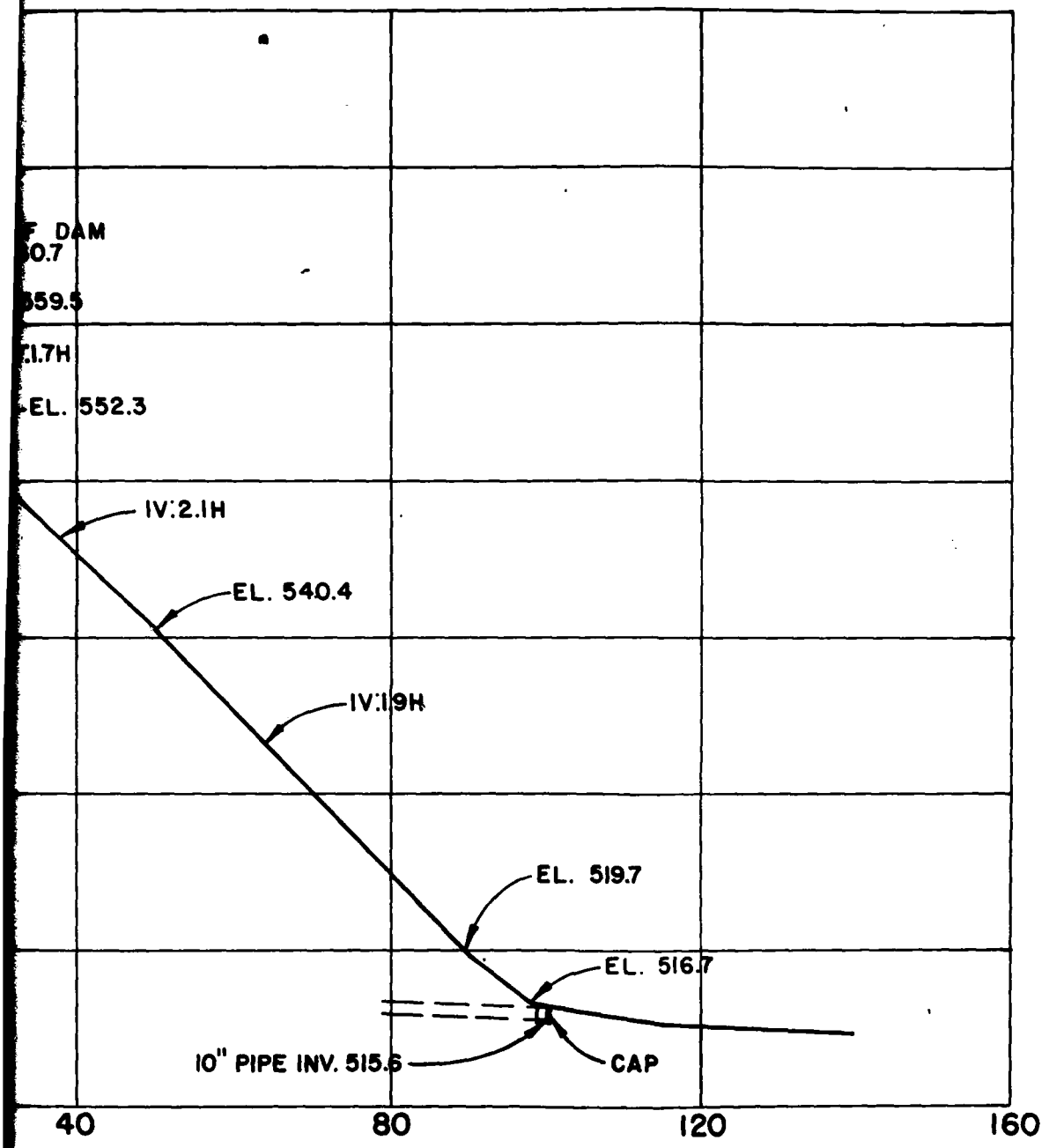
12

PLATE 4



DAM CROSS-SECTION ST

SCALES: 1"=10' V., 1"=20' H.

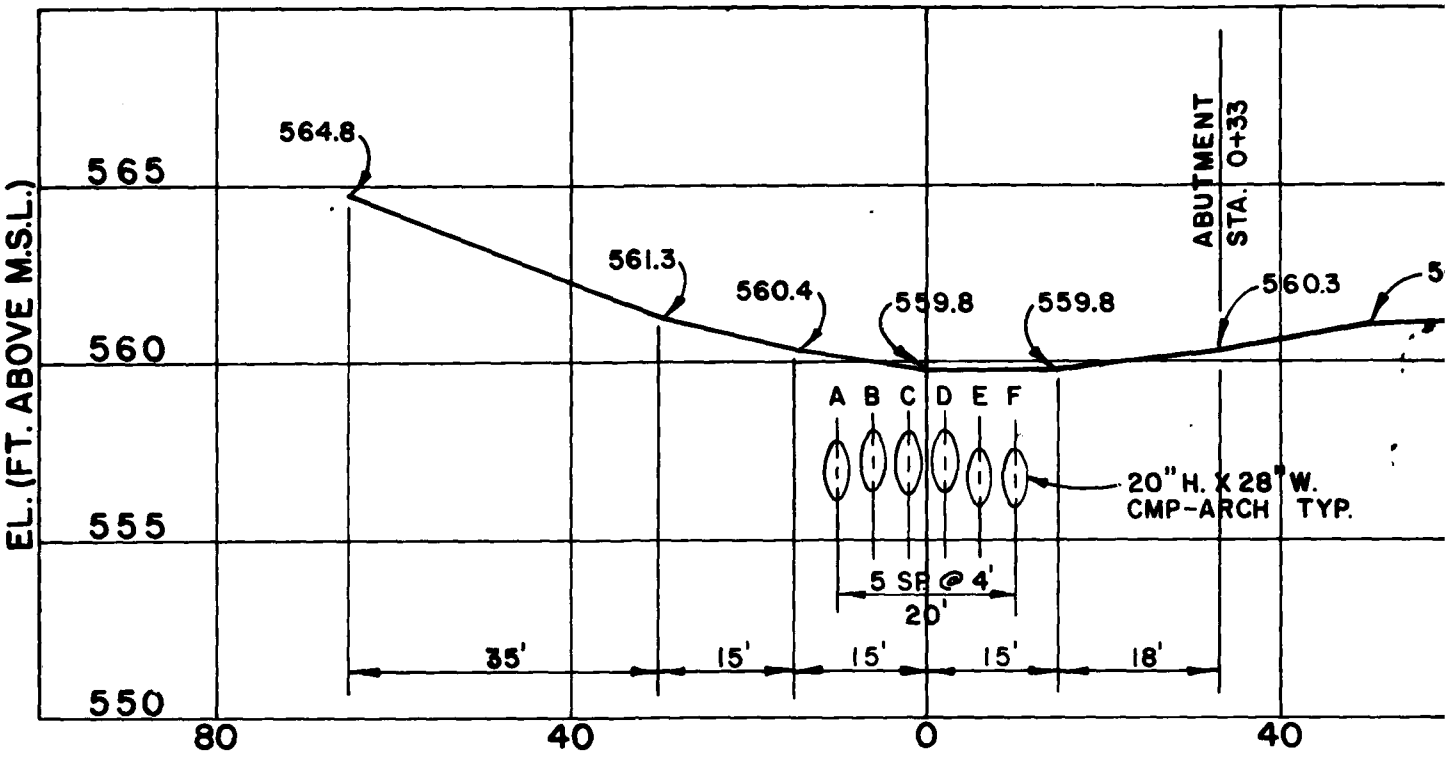


SECTION STA. 3+85

: 1"=10' V., 1"=20' H.

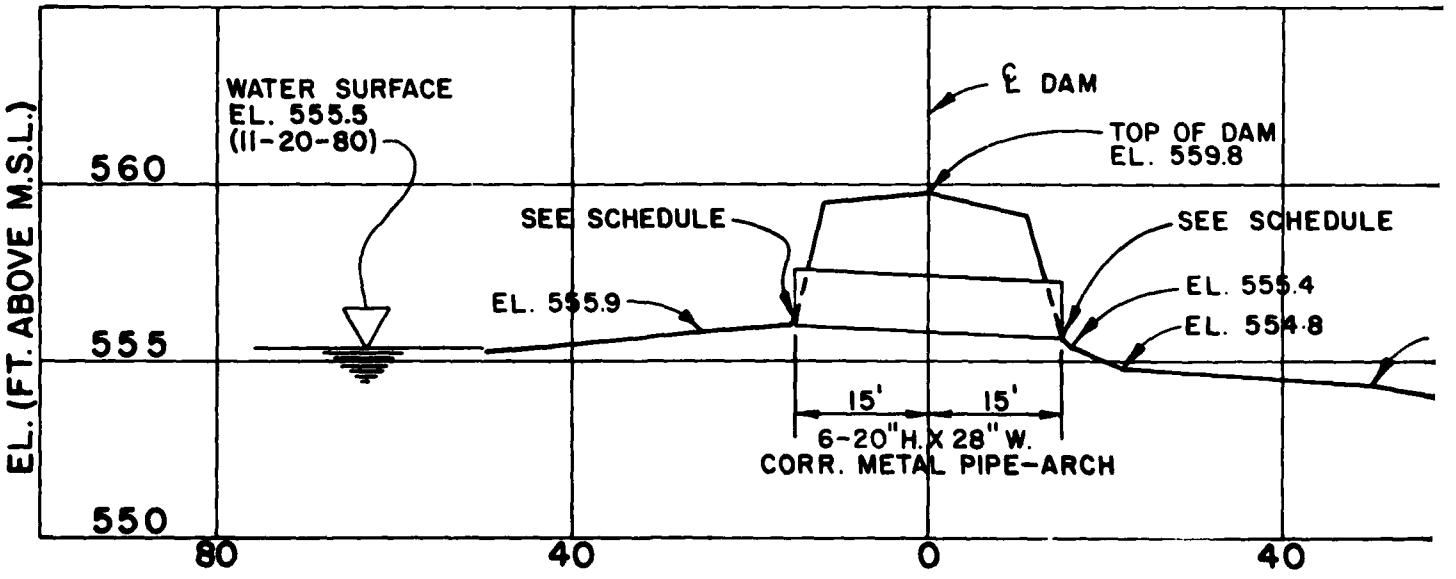
WILDWOOD LAKE
DAM CROSS-SECTION

Horner & Shifrin, Inc. Jan. 1981



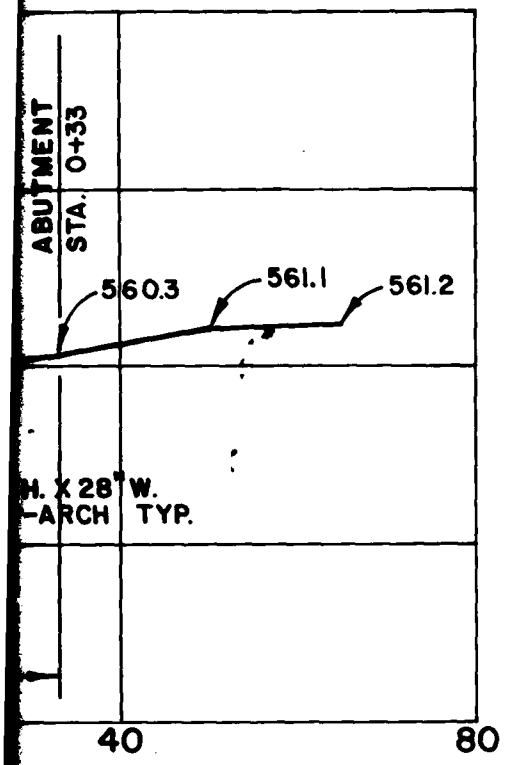
SPILLWAY CROSS-SECTION – ℄ DAM

SCALES: 1"=5' V., 1"=20' H.



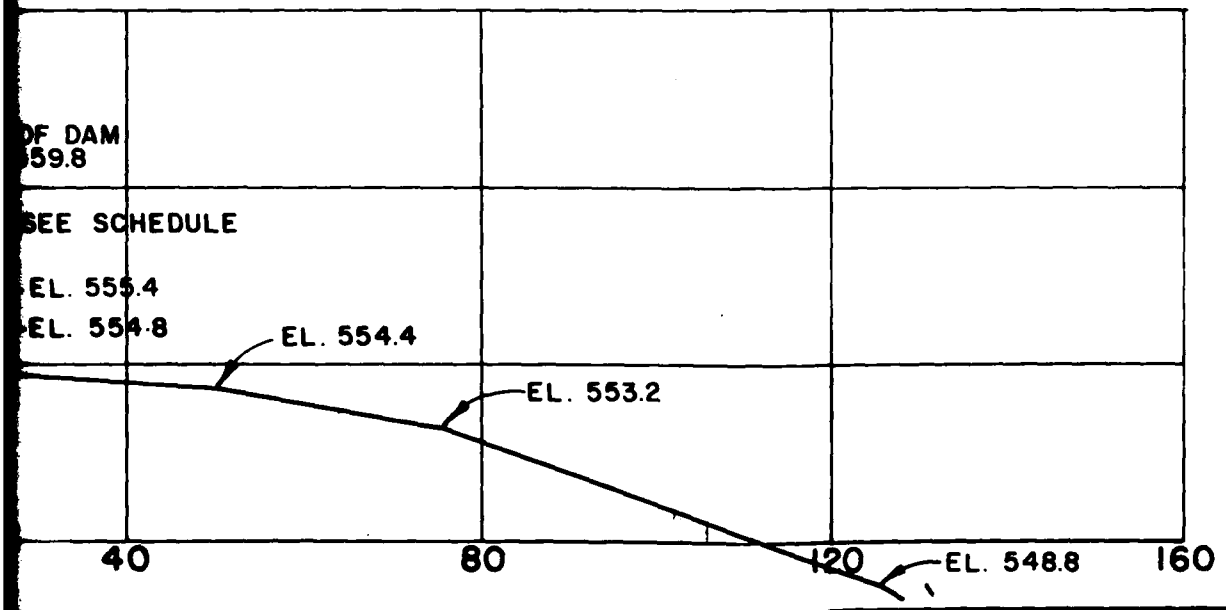
SPILLWAY PROFILE – STA. 0+00

SCALES: 1"=5' V., 1"=20' H.



SCHEDULE - PIPE INVERT ELEV.			
PIPE	SLOPE	UPSTR. INVERT. ELEV.	DOWN STR. INVERT. ELEV.
A	-0.0067	556.2	556.4
B	0	556.4	556.4
C	0.0167	556.4	555.9
D	0.0233	556.3	555.6
E	0.0167	556.0	555.5
F	0.0100	556.0	555.7

DAM



0

WILDWOOD LAKE
SPILLWAY PROFILE
& CROSS-SECTION

Horner & Shifrin, Inc. Jan. 1981

ENGINEERING GEOLOGY REPORT OF A LAKE DEVELOPMENT IN JEFFERSON COUNTY

LOCATION: NW¼ sec. 2, T. 39 N., R. 5 E., Hallifax Quadrangle.

The bedrock in this area is composed of flat, bedded, flaggy dolomite of the Jefferson City-Cotter-Powell Formations, with a very meager soil cover. It is recommended that no soil cover be removed from below proposed water line for the construction of the dam. Due to the excess watershed, it is felt that this dam would have a good chance for a success, provided that there is sufficient amount of core trench cut across the center line of the proposed dam. This core trench will, of necessity, involve drilling and blasting the dolomite bedrock. However, the bedrock should be cut and drilled by blasting back to such a point that all loose bedding planes have been intercepted. This should be done by a professional experienced in blasting techniques, to avoid undue fracturing of the bedrock, which could cause more problems in the future. All this material should be removed. If any black or dark bedding planes should appear, this indicates that there is some water movement along the bedding plane and it should be blasted out till these not longer exist. This is primarily true on the wide abutment looking downstream.

Edwin E. Lutzen, Geologist
Engineering Geology
Missouri Geological Survey
March 31, 1971

APPENDIX A

INSPECTION PHOTOGRAPHS

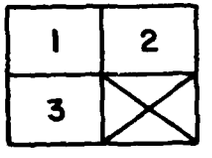
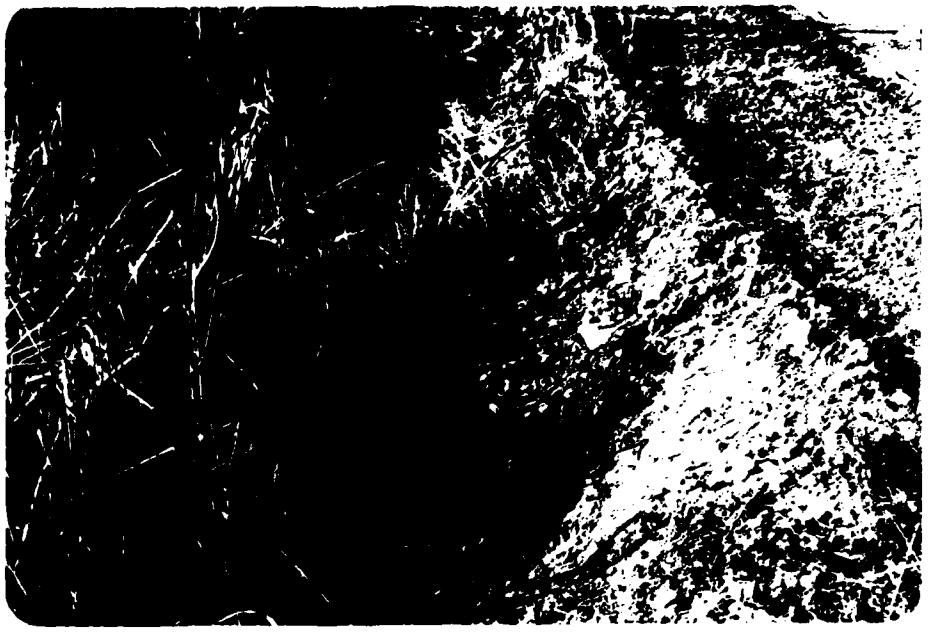


PHOTO KEY

NO.	DESCRIPTION
1	Dam Overview
2	Upstream Face of Dam
3	Downstream Face of Dam



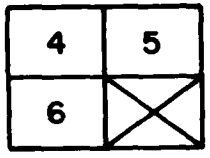


PHOTO KEY

NO.	DESCRIPTION
4	Spillway Approach Channel
5	Upstream End of Spillway Pipes
6	Downstream End of Spillway Pipes

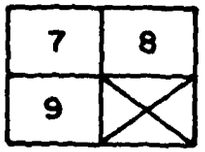
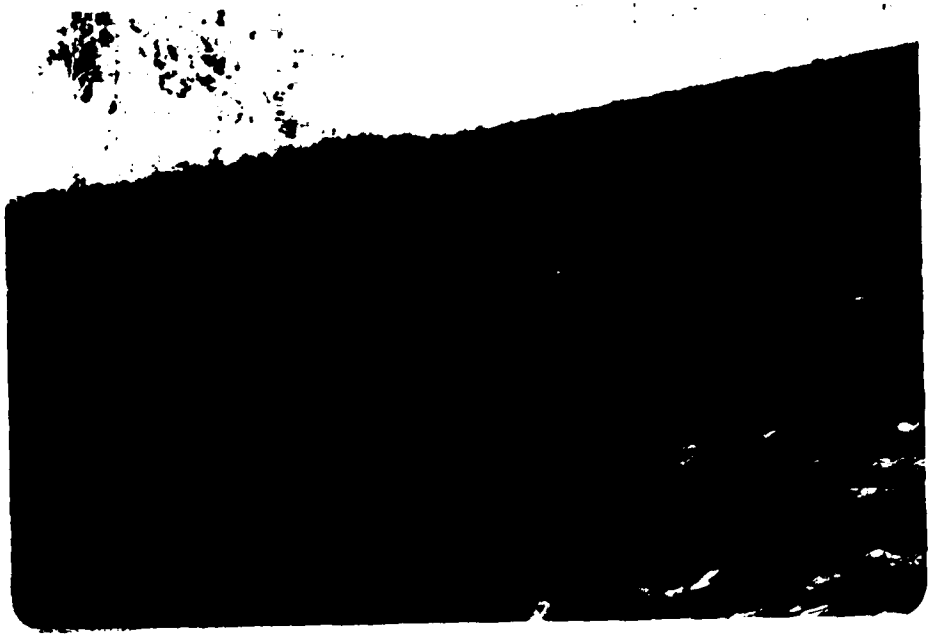


PHOTO KEY

NO.	DESCRIPTION
7	Spillway Outlet Channel - Looking Downstream From Dam
8	Erosion of Spillway Outlet Channel
9	Downstream End of 10-inch Drain Pipe



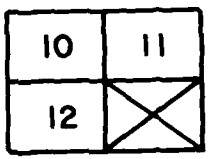


PHOTO KEY

NO.	DESCRIPTION
10	Marshy Area at Toe of Dam
11	Seepage in Marshy Area
12	Seepage at Original Stream Channel

APPENDIX B

HYDROLOGIC AND HYDRAULIC ANALYSES

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

1. The HEC-1 Dam Safety Version (July 1978, Modified 26 February 1979) program was used to develop inflow and outflow hydrographs and dam overtopping analyses, with hydrologic inputs as follows:

a. Probable maximum precipitation (200 sq. mile, 24-hour value equals 25.7 inches) from Hydrometeorological Report No. 33. The precipitation data used in the analysis of the 1 percent (100-year frequency) flood was provided by the St. Louis District, Corps of Engineers.

b. Storm duration = 24 hours; unit hydrograph duration = 5 minutes

c. Drainage area = 0.416 square miles = 266 acres.

d. SCS parameters:

$$\text{Time of Concentration } (T_c) = \left(\frac{11.9L^3}{H}\right)^{0.385} = 0.274 \text{ hours}$$

Where: T_c = Travel time of water from hydraulically most distant point to point of interest, hours
L = Length of longest watercourse = 0.796 miles
H = Elevation difference = 173 feet

The time of concentration (T_c) was obtained using Method C as described in Figure 30, "Design of Small Dams", by the United States Department of the Interior, Bureau of Reclamation, and was verified using average channel velocity estimates and watercourse lengths.

Lag Time = 0.164 hours (0.60 Tc)
Hydrologic soil group = 100% D (Gasconade Series per Missouri General Soil Map and field investigation)

Soil type CN = 77 (AMC II, 100-yr flood condition)
= 89 (AMC III, PMF condition)

2. Flow through the principal spillway, six 20-inch high by 28-inch wide corrugated metal pipe-arches (24-inch equivalent), was computed using Bernoulli's equation for pressure flow in pipes. A pipe friction factor (n) of 0.016 was used. Losses, including entrance, pipe and exit losses totaled 2.06 velocity heads. Reference "Handbook of Hydraulics", Fifth Edition, by King and Brater, pages 8-5 and 8-6.

Discharge quantities, determined by the method described herein, were plotted versus corresponding lake water elevations to determine the discharge rating curve for the spillway pipes.

3. The emergency spillway section consists of a broad-crested dish-shaped section surfaced with crushed stone.

Spillway release rates were determined as follows:

a. Spillway crest section properties (area, "a" and top width, "t") were computed for various depths, "d".

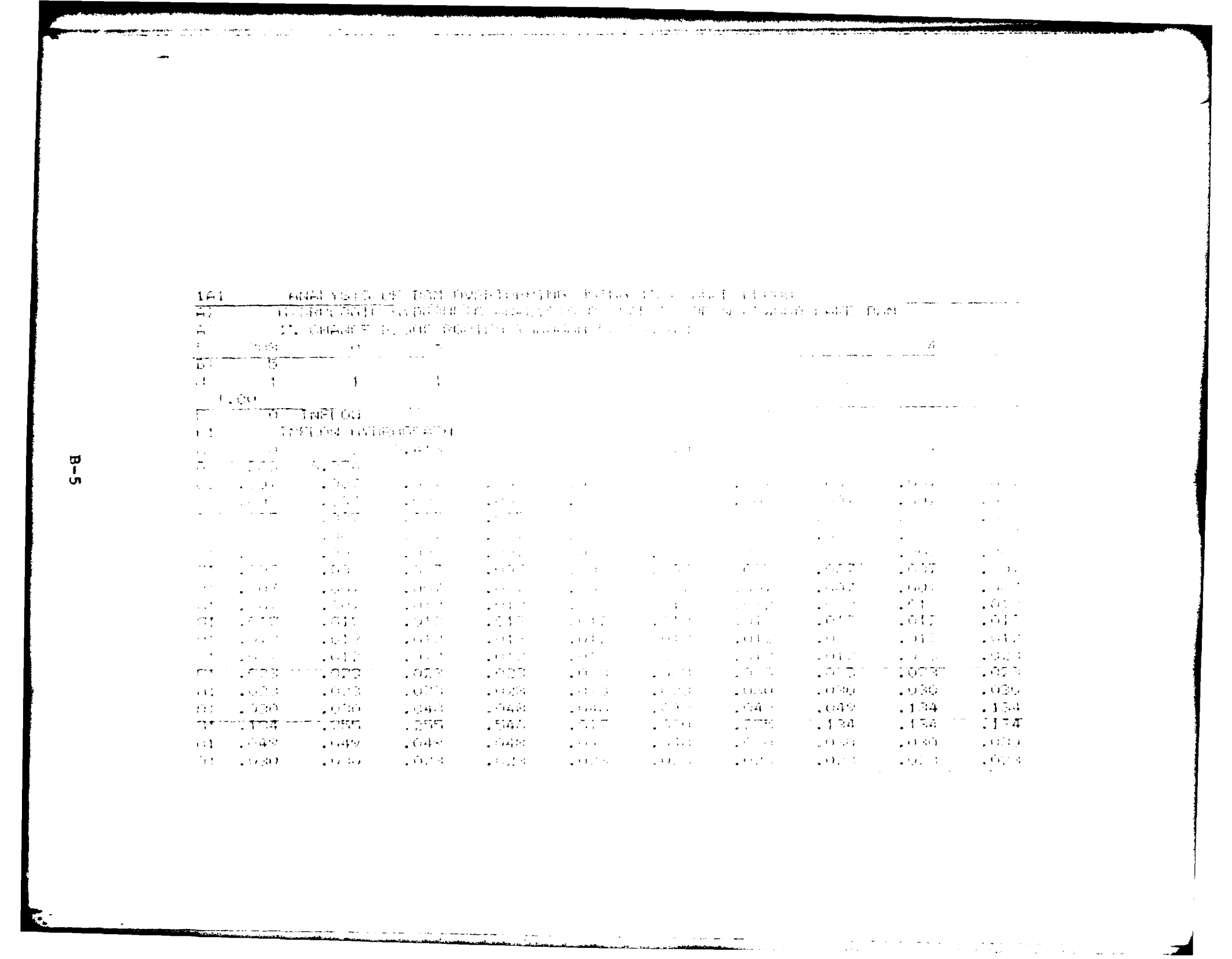
b. It was assumed that flow over the spillway crest would occur at critical depth. Flow at critical depth was computed as $Qc = \left(\frac{a^3 g}{t}\right)^{0.5}$ for the various depths, "d". Corresponding velocities (v_c) and velocity heads (H_{vc}) were determined using conventional formulas.* Reference, "Handbook of Hydraulics", Fifth Edition, by King and Brater, page 8-7.

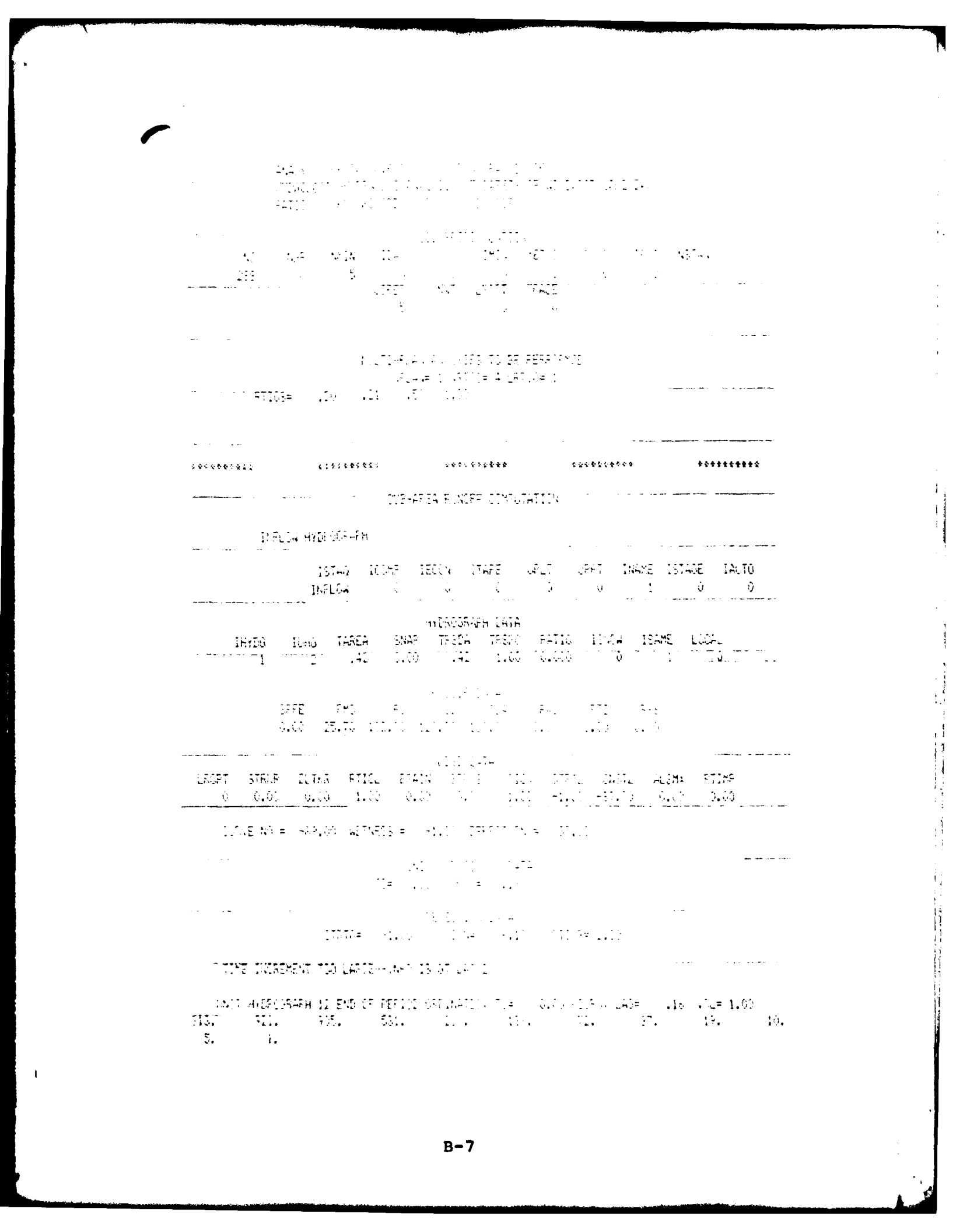
c. Static lake levels corresponding to the various values passing the spillway were computed as critical depths plus critical velocity head ($d_c + H_{vc}$), and the relationship between lake level and spillway discharge was thus obtained. The procedure neglects the minor insignificant friction losses across the length of the spillway.

* $v_c = \frac{Qc}{a}$; $Hvc = \frac{v_c^2}{2g}$

4. The discharges for the principal and emergency spillways for like elevations were summated for entry on the Y4 and Y5 cards.

5. The profile of the dam crest is irregular and flow over the dam cannot be determined by application of conventional weir formulas. Crest length and elevation data for the dam crest were entered into the HEC-1 Program on the $L and the $V cards. The program assumes that flow over the dam crest section occurs at critical depth and computes internally the flow over the dam crest and adds this flow to the flow over the spillway as entered on the Y4 and Y5 cards.

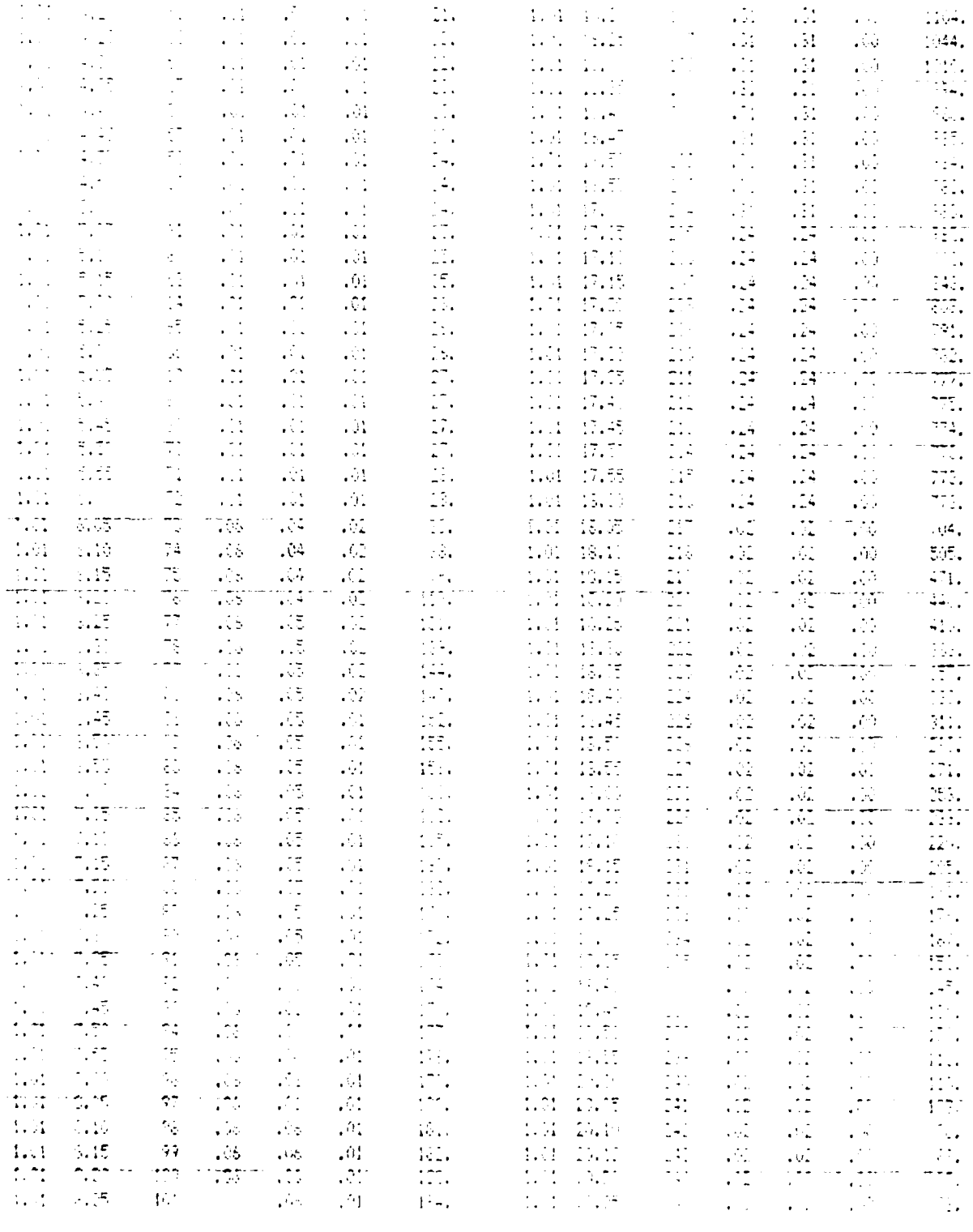




B-7

1.01	2.50	34	.01	.00	.01	12.	1.01	14.50	178	.33	.33	.00	1047.
1.01	2.55	35	.01	.00	.01	13.	1.01	14.55	179	.33	.33	.00	1048.
1.01	3.00	36	.01	.00	.01	12.	1.01	15.00	180	.33	.33	.00	1048.
1.01	3.05	37	.01	.00	.01	14.	1.01	15.05	181	.20	.20	.00	1009.
1.01	3.10	38	.01	.00	.01	14.	1.01	15.10	182	.40	.40	.00	953.
1.01	3.15	39	.01	.01	.01	15.	1.01	15.15	183	.49	.48	.00	1020.
1.01	3.20	40	.01	.01	.01	16.	1.01	15.20	184	.59	.59	.00	1194.
1.01	3.25	41	.01	.01	.01	15.	1.01	15.25	185	.70	.69	.00	1479.
1.01	3.30	42	.01	.01	.01	17.	1.01	15.30	186	1.69	1.69	.01	2096.
1.01	3.35	43	.01	.01	.01	17.	1.01	15.35	187	2.79	2.78	.01	3567.
1.01	3.40	44	.01	.01	.01	17.	1.01	15.40	188	1.10	1.09	.00	5059.
1.01	3.45	45	.01	.01	.01	15.	1.01	15.45	189	.70	.70	.00	4454.
1.01	3.50	46	.01	.01	.01	19.	1.01	15.50	190	.50	.50	.00	3796.
1.01	3.55	47	.01	.01	.01	19.	1.01	15.55	191	.41	.40	.00	2742.
1.01	4.00	48	.01	.01	.01	21.	1.01	16.00	192	.41	.40	.00	2240.
1.01	4.05	49	.01	.01	.01	21.	1.01	16.05	193	.31	.31	.00	1750.
1.01	4.10	50	.01	.01	.01	21.	1.01	16.10	194	.31	.31	.00	1429.
1.01	4.15	51	.01	.01	.01	21.	1.01	16.15	195	.31	.31	.00	1218.

END-OF-PERIOD FLOW (Cont'd)



END-OF-PERIOD FLOW (Cont'd)

1.01	9.00	108	.06	.06	.01	189.	1.01	21.00	252	.02	.02	.00	69.
1.01	9.05	109	.06	.06	.01	189.	1.01	21.05	253	.02	.02	.00	69.
1.01	9.10	110	.06	.06	.01	190.	1.01	21.10	254	.02	.02	.00	69.
1.01	9.15	111	.06	.06	.00	190.	1.01	21.15	255	.02	.02	.00	69.
1.01	9.20	112	.06	.06	.00	191.	1.01	21.20	256	.02	.02	.00	69.
1.01	9.25	113	.06	.06	.00	191.	1.01	21.25	257	.02	.02	.00	69.
1.01	9.30	114	.06	.06	.00	192.	1.01	21.30	258	.02	.02	.00	69.
1.01	9.35	115	.06	.06	.00	192.	1.01	21.35	259	.02	.02	.00	69.
1.01	9.40	116	.06	.06	.00	192.	1.01	21.40	260	.02	.02	.00	69.
1.01	9.45	117	.06	.06	.00	193.	1.01	21.45	261	.02	.02	.00	69.
1.01	9.50	118	.06	.06	.00	193.	1.01	21.50	262	.02	.02	.00	69.
1.01	9.55	119	.06	.06	.00	193.	1.01	21.55	263	.02	.02	.00	69.
1.01	10.00	120	.06	.06	.00	194.	1.01	22.00	264	.02	.02	.00	69.
1.01	10.05	121	.06	.06	.00	194.	1.01	22.05	265	.02	.02	.00	69.
1.01	10.10	122	.06	.06	.00	194.	1.01	22.10	266	.02	.02	.00	69.
1.01	10.15	123	.06	.06	.00	195.	1.01	22.15	267	.02	.02	.00	69.
1.01	10.20	124	.06	.06	.00	195.	1.01	22.20	268	.02	.02	.00	69.
1.01	10.25	125	.06	.06	.00	195.	1.01	22.25	269	.02	.02	.00	69.
1.01	10.30	126	.06	.06	.00	196.	1.01	22.30	270	.02	.02	.00	69.
1.01	10.35	127	.06	.06	.00	196.	1.01	22.35	271	.02	.02	.00	69.
1.01	10.40	128	.06	.06	.00	196.	1.01	22.40	272	.02	.02	.00	69.
1.01	10.45	129	.06	.06	.00	197.	1.01	22.45	273	.02	.02	.00	69.
1.01	10.50	130	.06	.06	.00	197.	1.01	22.50	274	.02	.02	.00	69.
1.01	10.55	131	.06	.06	.00	197.	1.01	22.55	275	.02	.02	.00	69.
1.01	11.00	132	.06	.06	.00	198.	1.01	23.00	276	.02	.02	.00	69.
1.01	11.05	133	.06	.06	.00	198.	1.01	23.05	277	.02	.02	.00	69.
1.01	11.10	134	.06	.06	.00	198.	1.01	23.10	278	.02	.02	.00	69.
1.01	11.15	135	.06	.06	.00	199.	1.01	23.15	279	.02	.02	.00	69.
1.01	11.20	136	.06	.06	.00	199.	1.01	23.20	280	.02	.02	.00	69.
1.01	11.25	137	.06	.06	.00	199.	1.01	23.25	281	.02	.02	.00	69.
1.01	11.30	138	.06	.06	.00	200.	1.01	23.30	282	.02	.02	.00	69.
1.01	11.35	139	.06	.06	.00	200.	1.01	23.35	283	.02	.02	.00	69.
1.01	11.40	140	.06	.06	.00	200.	1.01	23.40	284	.02	.02	.00	69.
1.01	11.45	141	.06	.06	.00	201.	1.01	23.45	285	.02	.02	.00	69.
1.01	11.50	142	.06	.06	.00	201.	1.01	23.50	286	.02	.02	.00	69.
1.01	11.55	143	.06	.06	.00	201.	1.01	23.55	287	.02	.02	.00	69.
1.01	12.00	144	.06	.06	.00	202.	1.02	0.00	288	.02	.02	.00	69.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6059.	1154.	304.	304.	1154.
CMS	171.	33.	9.	9.	33.
INCHES		25.21	6.64	6.64	25.21
MM		655.21	172.64	172.64	655.21
AC-FT		572.	151.	151.	572.
THOUS CU M		706.	186.	186.	706.

[illegible]=	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]CAPACITY=	0.	[illegible]	[illegible]	[illegible]	765.
ELEVATION=	[illegible]	[illegible]	[illegible]	[illegible]	5330.

[illegible]

PMF

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	ELEVATION	[illegible]	FLOWAGE EFFECT	END OF DAM
	STORAGE	[illegible]	144.	232.

[illegible]

	OUTFLOW		0.	1.		169.	
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE (AC-FT)	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	560.21	.07	[illegible]	1[illegible].	.22	17.08	0.00
.21	560.35	.11	[illegible]	21[illegible].	2.00	16.42	0.00
.50	561.53	1.33	[illegible]	72[illegible].	5.00	15.75	0.00
1.00	562.26	2.06	[illegible]	6[illegible].	7.42	15.75	0.00

[illegible]

1% CHANCE FLOOD

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

HORNER & SHIFRIN, INC.
CONSULTING ENGINEERS
5200 OAKLAND AVE. ST. LOUIS, MO. 63110

TITLE: Willwood Lake — Spillway Capacity

JOB NO. 1128 — SHEET NO. 3 OF — BY — DATE 11/22/80 — CHECKED — DATE

Elev.	A h	A V	A Q	B h	B V	B Q	C h	C V	C Q	D h	D V	D Q	E h	E V	E Q	F h	F V	F Q	ΣQ
48	Pipe																		
58.	1.0	4.38	12.8	0.9	4.38	12.5	0.8	5.20	16.3	0.9	5.77	18.1	1.2	5.94	18.7	1.2	5.58	17.5	96.4
60	3.	7.23	24.0	2.8	7.23	24.0		8.28	26.0		8.65	27.2		8.77	27.5		8.53	26.8	155.5
62	5.	10.05	31.4	4.8		31.4		10.49	33.0		10.79	33.9		10.88	34.2		10.69	33.6	197.5
64	7.	11.87	37.3			37.3		12.31	38.7		12.57	39.5		12.65	39.7		12.48	39.2	231.7
66	9.	13.52	42.5			42.5		13.90	43.7		14.12	44.4		14.20	44.6		14.05	44.1	261.8
68	11.	15.13	47.6			47.1		15.32	48.1		15.52	48.8		15.51	49.0		15.46	48.6	288.7
70	12	16.21	51.2			51.2		16.62	52.2		16.81	52.8		16.87	53.0		16.75	52.6	313.0
59.3	25	7.22	23.1			23.1		9.02	28.2		8.40	26.4		8.53	26.8		8.38	26.0	150.6 (1.12)

$Q = Ch^{3/2}$

1" Orifice

58	1.0	—		0.8			1.2			1.6			1.7			1.5		7.9	19.5
60	2			2.8			3.3			3.2			3			3.2		7.9	30.1
62																			
64																			
66																			
68	11			10.8			11.3			11.2			11.7			11.5		7.9	102.7

Orifice flow not critical

8-12

Emergency Spillway

Elev.	d		ΣA	ΣA	T	A^3/T	Q	V	Hv	d+Hv	Elev.
559.8	0			0	15	—	0				559.8
560.3	0.5	$(15+45.5)\frac{0.5}{2}$	15.12	15.12	45.5		49.5	3.27	0.17	0.67	560.47
560.4	0.6	$(45.5+48)\frac{0.1}{2}$	4.68	19.80	48.		72.2	3.64	0.21	0.81	560.61
561.3	1.5	$(48+63)\frac{0.9}{2}$	49.95	69.75	63.		416.5	5.97	0.55	2.05	561.85
562.2	2.4	$(63+73)\frac{0.9}{2}$	61.2	130.95	73		995.2	7.60	0.90	3.30	563.10
563.1	3.3	$(73+83)\frac{0.9}{2}$	90.2	201.15	83		1776.9	8.83	1.21	4.51	564.31
564.0	4.2	$(83+91)\frac{0.8}{2}$	78.3	279.45	91		2738	9.95	1.54	5.74	565.74
564.8	5.0	$(91+98)\frac{0.7}{2}$	75.6	355.05	98		3934.9	10.80	1.81	6.81	566.61
565.6	5.8	$(98+105)\frac{0.7}{2}$	81.2	436.25	105		5045.9	11.57	2.08	7.88	567.68

Data for V4/15 Curves

Elev.	Qmin.	Qmax	Eq
556.0	0	0	0
557.0	54		54
558	96		96
559.	130		130
559.8	151	0	151
560.	156	8	164
560.61	169	72	241
561.85	192	417	609
563.10	219	995	1214
564.31	238	1777	2015
565.74	256	2777	3033

HORNER & SHIFRIN, INC.
CONSULTING ENGINEERS
5200 OAKLAND AVE ST. LOUIS, MO 63110

TITLE: Wildwood Lake

SHEET NO. 5A OF
SUBJECT FILE Spillway Capacity
BY ZHH DATE 11/25/87 CHECKED DATE
JOB NO. 87028